Iron and Steel ENGINEER

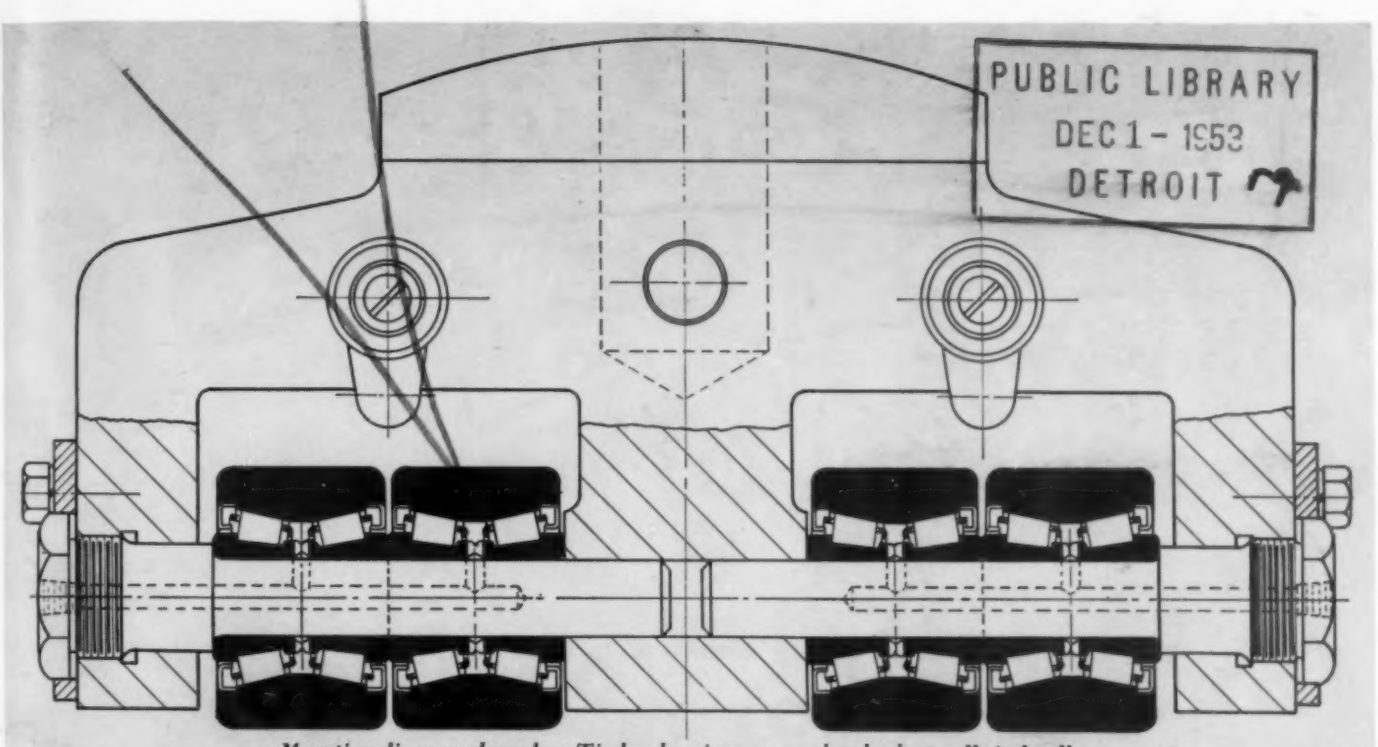
ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

NOVEMBER, 1953

ECHNOLOGY DEPT.

TABLE OF CONTENTS, Page 53

PUBLIC LIBRARY
DEC 1 - 1953
DETROIT



Mounting diagram shows how Timken bearings are used as back-up rolls in levellers.

How TIMKEN® bearings as back-up rolls keep levellers from marking sheets

WITH Timken® bearings as back-up rolls, levellers flatten sheets without marking, give long, trouble-free performance. Because Timken bearings practically eliminate friction, they easily accelerate to top speeds. As a result, skidding and scuffing between work roll and back-up roll is reduced. This helps eliminate marking of the sheets. And because these bearings are both anti-friction bearings and back-up rolls, design is greatly simplified.

The OD of the outer race of each Timken bearing is the surface that contacts and supports the work roll. Because of the extremely smooth surface finish of the OD of these bearings, the work rolls are not marked with the result that the sheets are also unmarked.

Finally, Timken bearings are able to take the tremendous radial loads set up by this operation. Line contact between the rollers and races gives them the load carrying capacity to take these loads with ease. Tapered construction allows Timken bearings to carry both radial and thrust loads in any combination. Deflection and end-movement of shafts and rolls is eliminated.

Always specify Timken bearings for the machines you build or buy. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

NOT JUST A BALL ◯ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭ BEARING TAKES RADIAL ⬭ AND THRUST ⟷ LOADS OR ANY COMBINATION ⟷

the Crane SAFETY LIMIT STOP

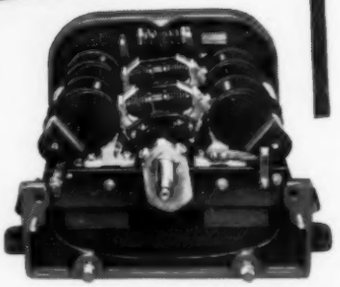
...THAT SET *New Standards of Performance*

There probably has never been a crane safety limit stop switch that so completely embodies *all* the wants of steel mill engineers as the Type P-100 Cutler-Hammer Safety Limit Stop, for 41 to 100 H.P. installations or the P-200 Safety Limit Stop for 101 to 200 H.P. installations. This is demonstrated by the fact that time after time engineers have taken one look at it and said: "That is what I want".

C-H Type P-100 100 H. P.

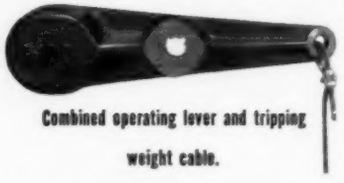
C-H Type P-200 200 H. P.

The photographs shown here tell their own story . . . a story of simple design . . . of rugged construction . . . of dependable, unfailing operation. The Cutler-Hammer Crane Safety Limit Stop has set new standards of performance every time, every way. CUTLER-HAMMER, Inc., 1269 St. Paul Ave., Milwaukee 1, Wis. *Associate*: Canadian Cutler-Hammer, Ltd., Toronto.



Movable contacts and arc shields in position. (Operating head removed).

Inside view of removable head, showing snap action mechanism.



Combined operating lever and tripping weight cable.

CHECK THESE OUTSTANDING FEATURES

Low headroom required.

Totally enclosed tripping mechanism—can't be made inoperative by rain, snow, ice, dirt or falling objects.

Slate contact supports, slotted, provide ample insulation to ground.

Snap action make and break—hammer blow of tripping is absorbed by spring bumper.

Cover strong enough to support a man's weight.

Rigid one-piece construction of operating lever and tripping weight.

Only one hanging weight, and that has double guides, adjustable to meet any practical installation condition, to prevent fouling the weight by the hoisting cables.

The snap action is obtained from a compression spring, with a very low unit stress. Even if it should break, the mechanism will operate because spring is held in place by an inside guide.

Ball bearings, with sealed in lubrication, used throughout.

Flexible leads brought out for ease of installation.

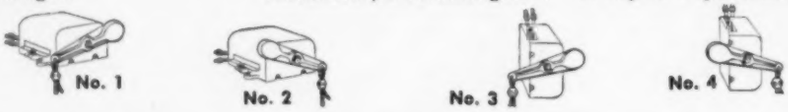
Gasketed cover to keep out dirt.

Mounting interchangeable with old style P-2.

Blowouts latched in place when mounted in position (3) or (4).

Cover chained to case to prevent dropping to ground during inspection.

(Below) Operating lever can be mounted in any of 4 quadrants.



CUTLER-HAMMER
MOTOR CONTROL
C-H

IRON AND STEEL ENGINEER, published monthly by Association of Iron and Steel Engineers, 1010 Empire Bldg., entered as second class matter January 25, 1924 at Pittsburgh, Pennsylvania, under Act of Congress, March 3, 1879. $7.50 per year in United States and Canada. $10.00 foreign countries. Volume 30, No. 11.

Nodular Iron (*magaloy*) Rolls

produce spectacular rolling tonnage

✻ Typical comments illustrate the spectacular results with Nodular Iron Rolls.

"With your Magaloy (Aetna's trade name) strip mill and skelp mill rolls, I have increased rolling tonnage (before redressing) as much as 50% over steel rolls."

Another user reports he has switched to nodular iron rolls because of savings in breakage over alloy iron rolls.

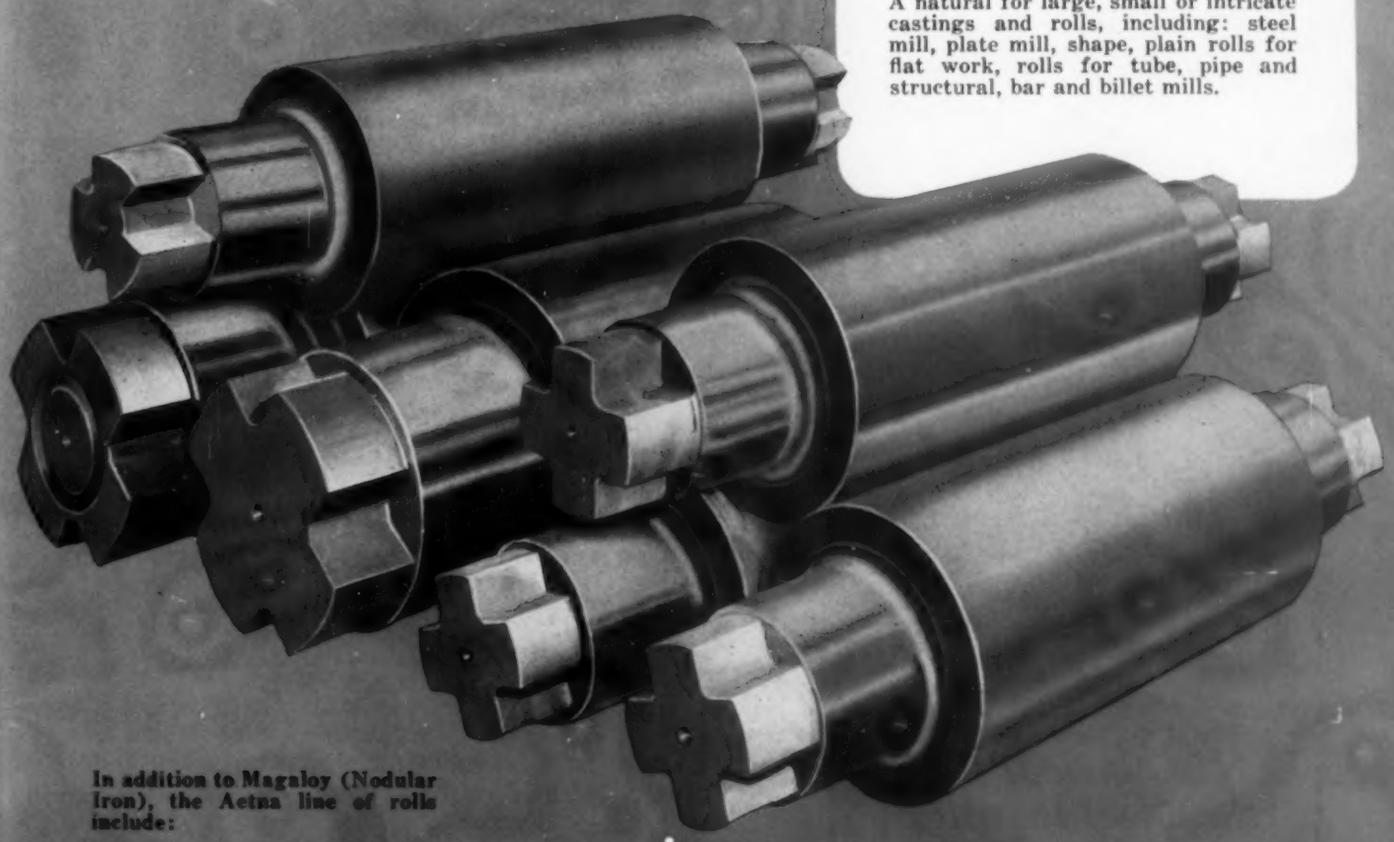
Aetna's roll specialists can give you data on Magaloy Rolls. Their services are available upon request.

UNUSUAL PROPERTIES

Nodular Iron does not roughen up; responds to heat treatment; has better casting properties than steel; physical properties similar to plain carbon steels; lower cost than steel.

APPLICATIONS

A natural for large, small or intricate castings and rolls, including: steel mill, plate mill, shape, plain rolls for flat work, rolls for tube, pipe and structural, bar and billet mills.



In addition to Magaloy (Nodular Iron), the Aetna line of rolls include:

PLAIN CHILL	ASEX GRAIN
MOLY CHILL	PIPE MILL
NICKEL CHILL	RUBBER MILL
ALANITE A-B	PLASTIC MILL

THE AETNA-STANDARD ENGINEERING COMPANY • PITTSBURGH, PA

Aetna-Standard

PLANTS IN WARREN, OHIO • ELLWOOD CITY, PENNSYLVANIA

SUBSIDIARY and ASSOCIATED COMPANIES

Head Wrightson Machine Company, Ltd., Middlesbrough, England — Great Britain, Finland, Sweden, Norway, Denmark, Union of South Africa, Northern and Southern Rhodesia.

Aetna-Standard Engineering Company, Ltd., Toronto, Ontario, Canada.

M. Castellvi, Inc., New York, N. Y. — Mexico, Central and South America.

Societe de Constructions de Montbard, Paris, France — France, Belgium, Holland, Luxembourg, Switzerland.

Demag Aktiengesellschaft, Duisburg, Germany — Germany, Austria, Yugoslavia, Greece, Turkey, Egypt.

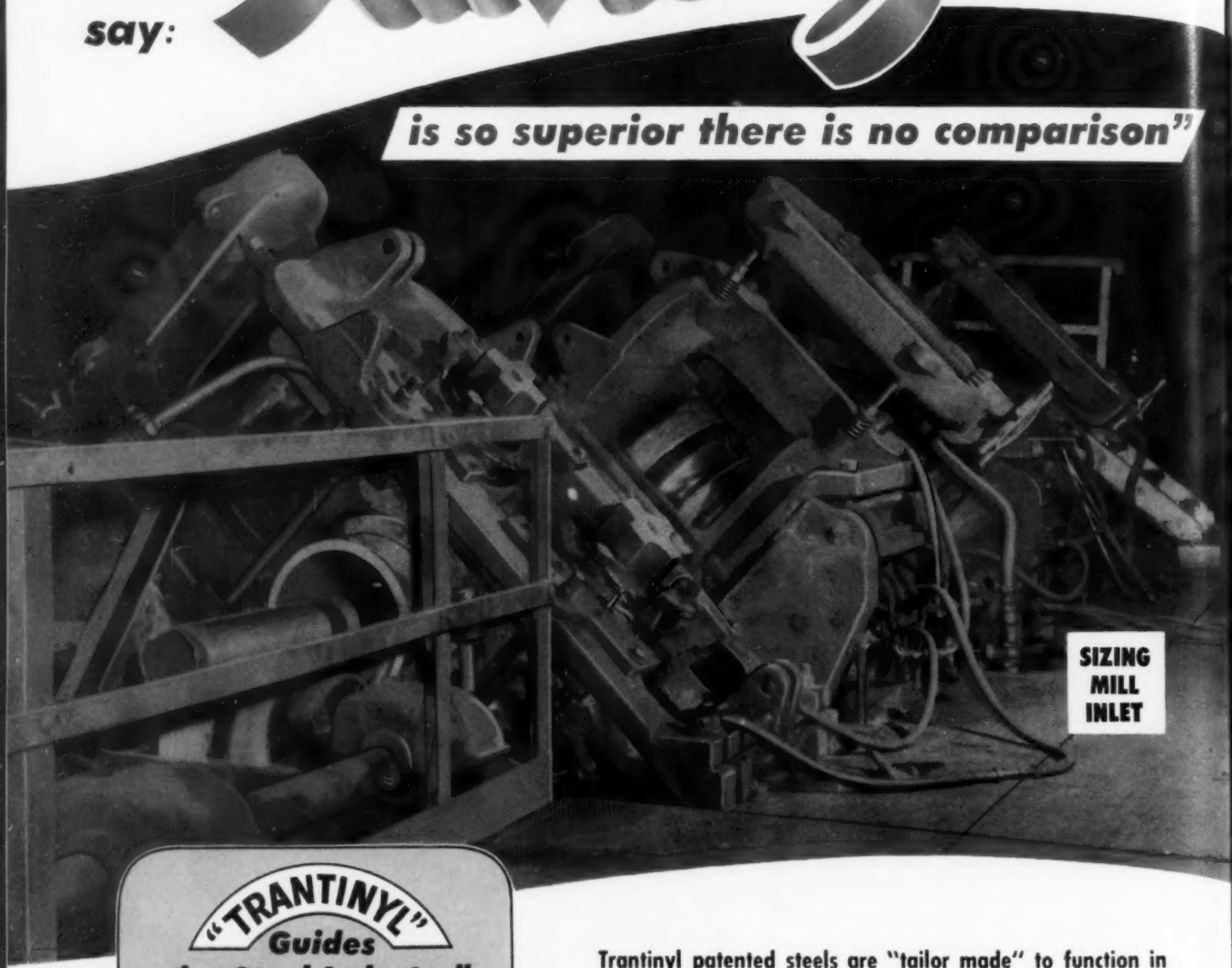
Compagnia Italiana Forme Acciaio, Milano, Italy — Italy.

Aetna-Japan Company, Ltd., Tokyo, Japan — Japan.

Hale & Kulligren, Inc., Akron, Ohio — Representative for the Rubber Industry.

Designers and Builders to the Ferrous, Non-Ferrous, Leather, Rubber, and Plastic Industries

TUBE MILL MEN say: "Trantinyl is so superior there is no comparison"



"TRANTINYL" Guides the Steel Industry"

SEAMLESS TUBE MILLS:
guide shoes, rolling mill plugs and rolls, piercer points, etc.

•

ELECTRIC WELD TUBE MILL:
forming rolls, planishing rolls, tool holders, etc.

ROLLING MILLS:
bar, hoop, strip, shape mill guides; and rollers

STRAIGHTENING MACHINE GUIDES

HEAT RESISTING CASTINGS

"TRANTINYL No. 1" CAST TO SHAPE

T4

Trantinyl patented steels are "tailor made" to function in specific operations such as piercing, guiding, rolling, sizing, etc. Trantinyl has won the approval of tube mill men through a quarter-century of superior performance.

Youngstown Alloy Casting Corp.
Youngstown, Ohio

Gives white hot steel the "kid glove" treatment

GIGANTIC MACHINES with thousands of moving parts are used to shape white hot ingots into plates and sheets. All of these hard-working machine parts are subject to intense heat . . . normal in steel manufacturing. Because of the intense heat, lubrication is a serious problem.

U. S. Steel has tried various types of greases in order to eliminate the problem of oil burn-out. Now they're using a product of Shell Research, Shell Alvania Grease. Result: better lubricating action *at once*. Months after the original installations, rollers were removed and an excellent film of grease was still present.

At the other extreme, zero weather caused grease in an automatic lubricating system to congeal and become unpumpable. Shell Alvania was tried and clogging promptly stopped. This multi-purpose grease is now used extensively in low-temperature operations at U. S. Steel's Ohio Plant.

SHELL ALVANIA GREASE

- **resists oxidation**
- **will not squeeze out**
- **extends periods between overhauls**
- **provides exceptional lubrication in high or low operating temperatures.**

Shell Alvania Grease can cut down costly maintenance and save time and money in *your* plant. Write for technical information.

SHELL OIL COMPANY

50 WEST 50TH STREET
NEW YORK 20, NEW YORK

100 BUSH STREET
SAN FRANCISCO 6, CALIFORNIA

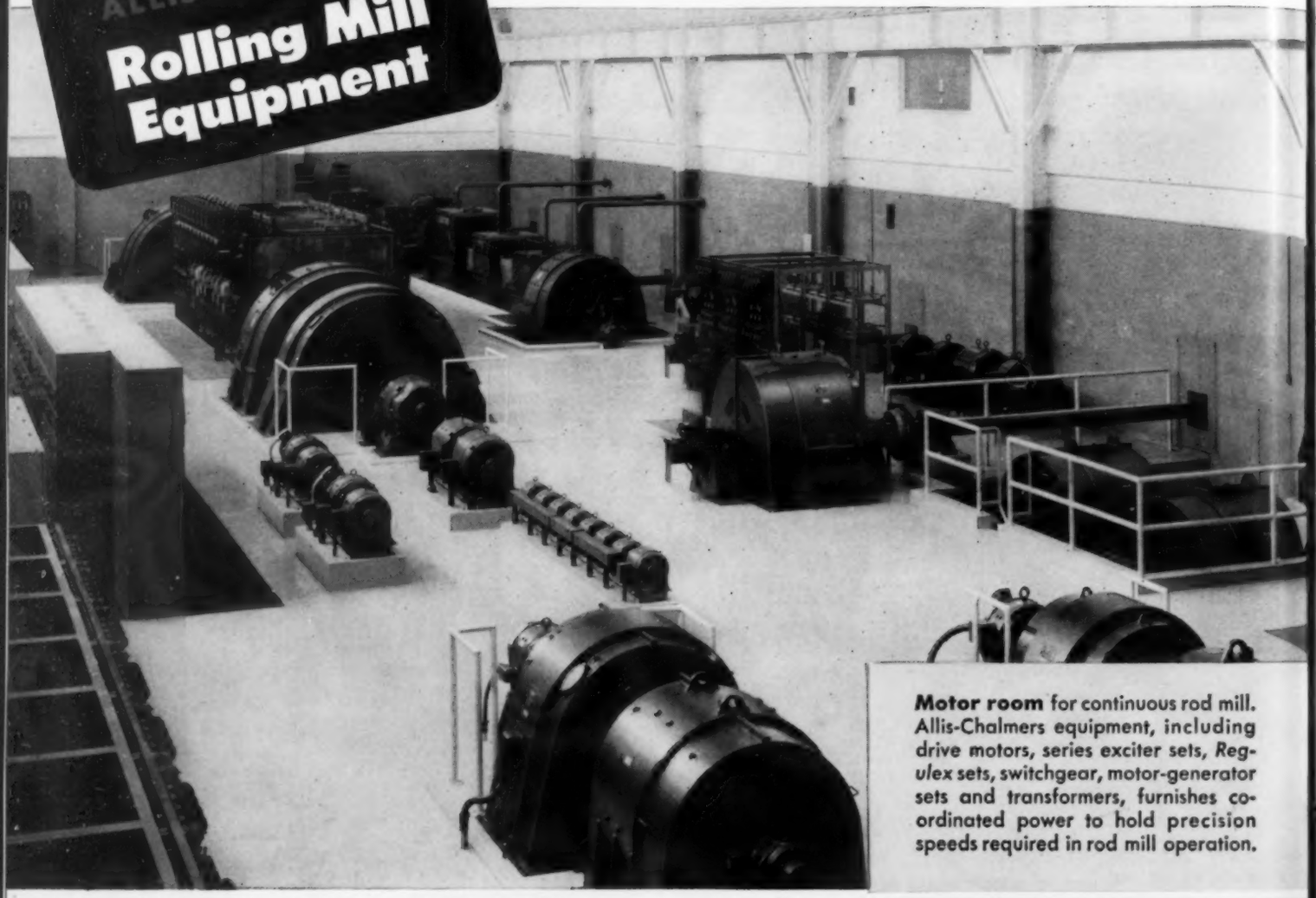
SHELL

Continental Steel's

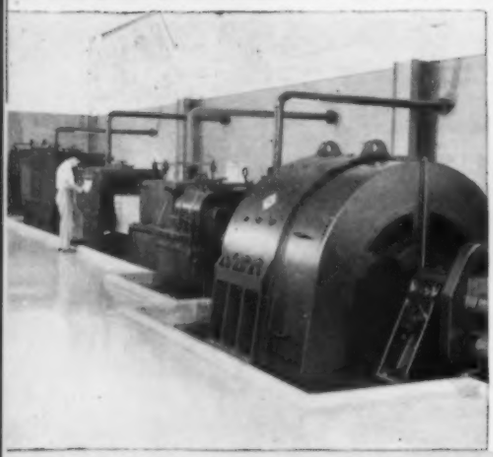
Now in Operation

ALLIS-CHALMERS

Rolling Mill Equipment

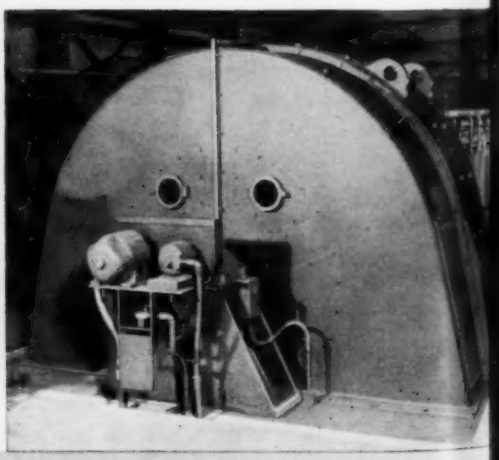


Motor room for continuous rod mill. Allis-Chalmers equipment, including drive motors, series exciter sets, *Regulex* sets, switchgear, motor-generator sets and transformers, furnishes coordinated power to hold precision speeds required in rod mill operation.



Roughing stand drives in the motor room. The 400-hp, 300/900-rpm dc motor in the background drives stands 1 and 2, and the 1500-hp, 300/750-rpm dc motor in the foreground drives roughing stands 3 through 8.

Intermediate stand drives in motor room. Three of the four 800-hp, 300/900-rpm dc motors driving stands 9 through 16. Larger rods are taken directly from these stands without passing through the finishing stands.



Finishing stand drive in the mill proper. This Allis-Chalmers 2000-hp, 300/600-rpm dc motor drives stands 17 through 22. Any number of these six stands may be used to run a variety of small rod sizes.

NEW ROD MILL
at Kokomo, Indiana

AN IMPORTANT PART of Continental Steel Corporation's expansion program to satisfy growing demands for their wire products is the specially designed Allis-Chalmers equipment controlling and driving the 22 stands in this all-new continuous rod mill.

Allis-Chalmers motors and controls are responsible for furnishing the precision speeds required in processing rod from billet to finished product. Each stand must be perfectly coordinated with the others to receive and pass rod from a starting speed equal to a walk and progressing to a finishing speed approximating 60 miles per hour.

Simplified Control

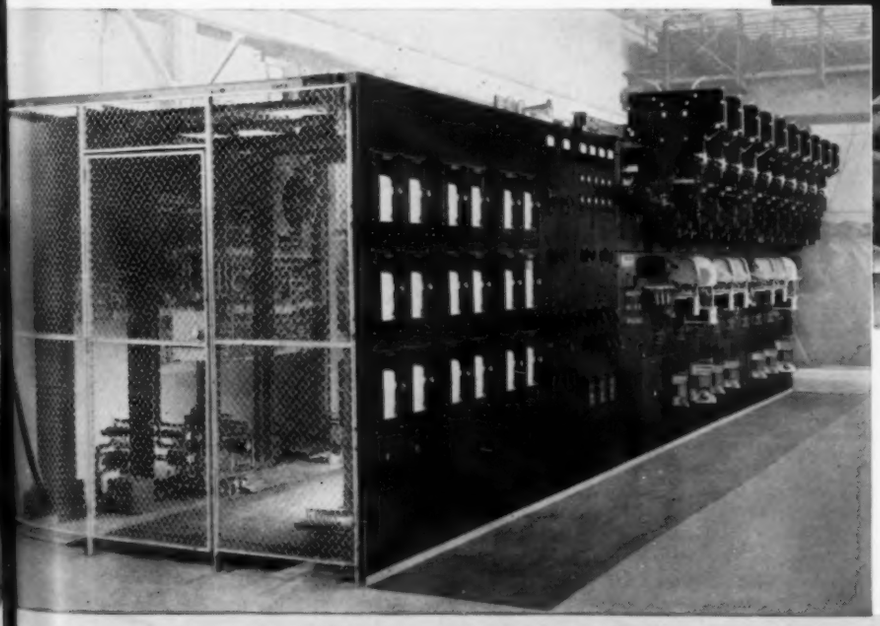
The seven drive motors are standard rolling mill types, engineered to meet the mill requirements and to operate through a simplified speed control system regulating motor field circuits with individual series exciters. Satisfactory mill operation, running three rods simultaneously, has produced 24 coarse and fine rod sizes from 0.218 to 0.681 inch, with projected use up to 1.125 inches.

This mill system gives Continental the benefits of flexibility and adaptability, with quality control not limited to a particular product size. Simplified control and durability are features Allis-Chalmers engineers have used to assure low maintenance costs.

For specific information on control, drives, and other electrical equipment to meet the needs of your expansion or conversion program, contact A-C office nearest you or write to Allis-Chalmers, Milwaukee 1, Wisconsin. A-4151

Regulex is an Allis-Chalmers trademark.

Pulpit control for rod processing. From this vantage point the operator controls stand speeds varying from 38 to 114 feet per minute at the start of roughing, to finishing speeds of 5000 feet per minute.



Variable voltage control panel (left) in the motor room for the main drive motors.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

Power, Electrical, Processing Equipment for Iron and Steel

are you using hardfacing effectively ?

BE SURE—READ AMSCO'S NEW CATALOG ON HARDFACING ALLOYS

Whatever the application, whenever you are in doubt about what hardfacing alloy to use, you can reach for the new Amsco Catalog for the answer. It gives you complete analyses, metallurgical information, and other pertinent data about Amsco's line of automatic and manual hardfacing alloys. You can look up the right rod to use for hundreds of the more common applications. And for those extra tough jobs, you'll find the section on How to Select a Hardfacing Alloy indispensable. Although it's written by welding engineers, this new catalog is easy to understand and to apply its suggestions to your own operations.

It's FREE—write to Amsco today for your copy

AMERICAN MANGANESE STEEL DIVISION

411 East 14th Street • Chicago Heights, Ill.

Other Plants: New Castle, Del., Denver, Oakland, Cal., Los Angeles, St. Louis. In Canada: Joliette Steel Division, Joliette, Que. Amsco Welding Products distributed in Canada by Canadian Liquid Air Co., Ltd.

CONTINENTAL

MERCHANT BAR MILL

Rolling Mill installations engineered complete

for steel, alloy and non-ferrous metals

BLOOMING MILLS
STRUCTURAL MILLS
RAIL MILLS
BILLET MILLS
ROD MILLS
BAR MILLS
MERCHANT MILLS

★ ★ ★

SLABBING MILLS
UNIVERSAL MILLS
PLATE MILLS
HOT STRIP MILLS
COLD STRIP MILLS
TEMPER MILLS

★ ★ ★

Mills complete with Auxiliary Equipment

★ ★ ★

ROLL LATHES
CONTINENTAL CHIPPER
SPECIAL MACHINERY

★ ★ ★

CASTINGS—carbon and alloy steel from 20 to 250,000 pounds

ROLLS—iron, alloy iron and steel rolls for all types of rolling mills

WELDMENTS—fabricated steel plate, or cast-weld design

* * *

CHICAGO • PITTSBURGH

Plants at:
East Chicago, Ind.
Wheeling, W. Va.
Pittsburgh, Pa.

CONTINENTAL
Foundry & Machine
Company

HERE'S VISUAL PROOF that JOY PLUGS are Distortion-Proof

Taken at one two-thousandths of a second, unretouched photo reproduced above shows a JOY 372M electrical connector absorbing the full impact of a heavily swung 10 lb. sledge hammer. Punished by twenty-four (24) similar blows while being so photographed the connector was then thoroughly tested for defects with results as reported at right.

When the problem is selecting electrical connectors for industrial applications and units in use *haven't quite measured up to requirements,* it's time to switch to JOY. Factory molded into one-piece Neoprene insulated units, JOY connectors can't crack or be smashed out-of-shape when dropped — won't become mushy when smeared with grease or oil — and are absolutely moisture-tight. Cork-like action of their Water-Seal also prevents metallic dust from accumulating around contacts when they're connected. Why accept less when the best actually *costs less* in the long run?

TEST REPORT

Date: 2-4-53 No. 387

OBJECT:

To determine the effect of heavy blows on a 372M connector.

PROCEDURE:

A 372M plug was selected at random from stock, placed on an anvil and struck 24 times with a 10 lb. sledge hammer. Impact force of each blow being approximately 40 foot pounds.

TEST DATA:

VISUAL INSPECTION: No distortion of original shape. Center pin slightly misaligned, however plug's ability to engage mating connectors unimpaired.

FLUOROSCOPE INSPECTION: Conductors intact and undamaged. No intermittent electrical opens in wiring.

ELECTRICAL TEST: 1500 volts AC RMS applied for 5 continuous minutes. Insulation between contacts did not break down.

COMMENTS:

JOY 372M plug relatively undamaged by blows described above. Should still render many years of satisfactory service under normal conditions.

Alfred V. Mucci

A. V. MUCCI
Supervisor Inspection

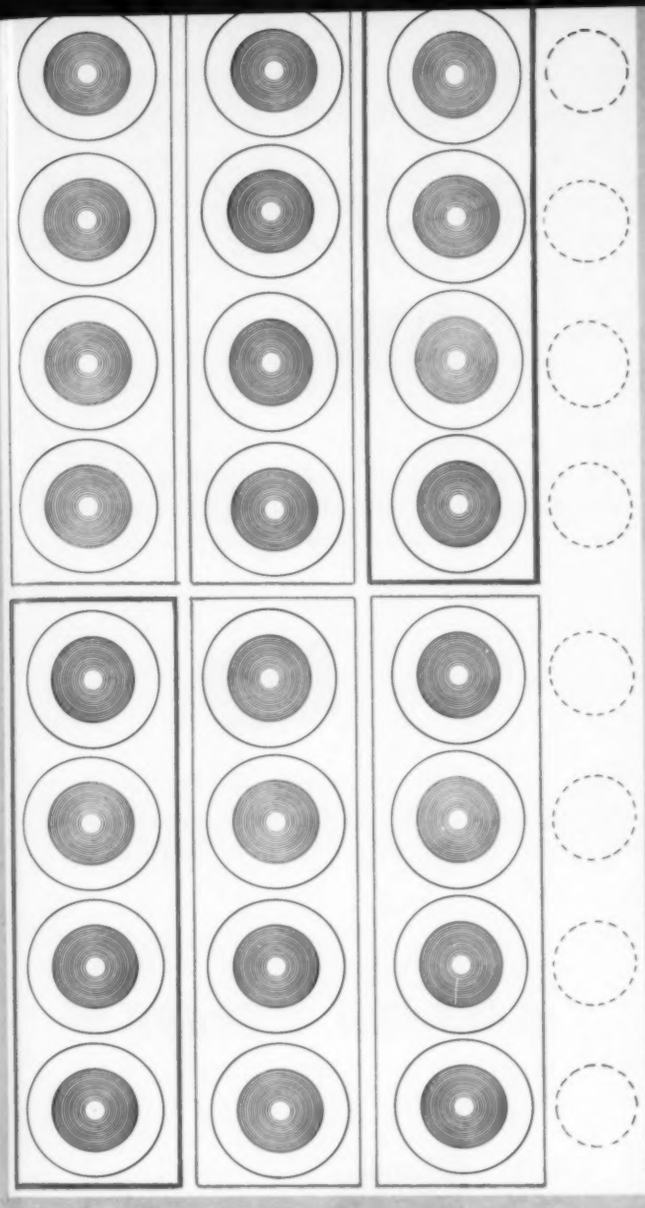
Ask for your free copy of this attractive two-color sixteen page Bulletin. Numbered MC108 it illustrates and describes many of the popular electrical plugs and receptacles JOY makes for Industry.

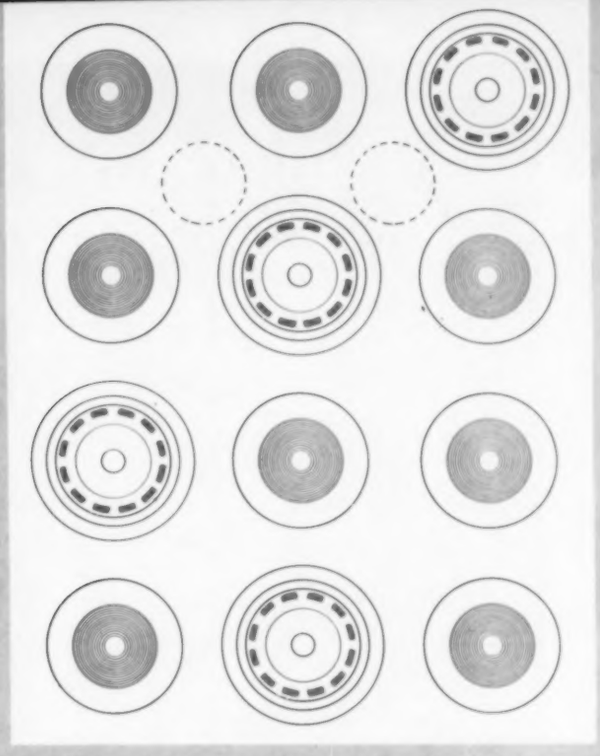
Consult a Joy Engineer

More than 100 years of Engineering Experience

JOY MANUFACTURING COMPANY
HENRY W. OLIVER BUILDING, PITTSBURGH 22, PENNSYLVANIA
IN CANADA: JOY MANUFACTURING COMPANY (CANADA) LTD., GALT, ONTARIO

M.E. 353.3





The rules of the game are simple. Take any quantity of steel you want annealed. Figure the time and the moves required to anneal that amount in present-day multiple-stack furnaces. Add sufficient time for furnace maintenance.

Now take the same quantity and figure it for the new Lee Wilson Portable-Base Single-Stack System of annealing. First, double the furnace speed, because the single-stack furnace heats and cools twice as fast. Next, cut down the time required for crane handling of equipment, because the single-stack equipment is smaller and lighter and can be handled easier and there's usually ample storage space for the inner cover close by

Every person interested in sheet and tin coil annealing should play this game

the base being unloaded. Then, eliminate the expensive, non-productive figure for furnace down-time, because the new portable base is quickly disconnected and carried to a repair station and a floating base is dropped in place and, with three simple connections, is ready to go. Time to change bases — 15 minutes.

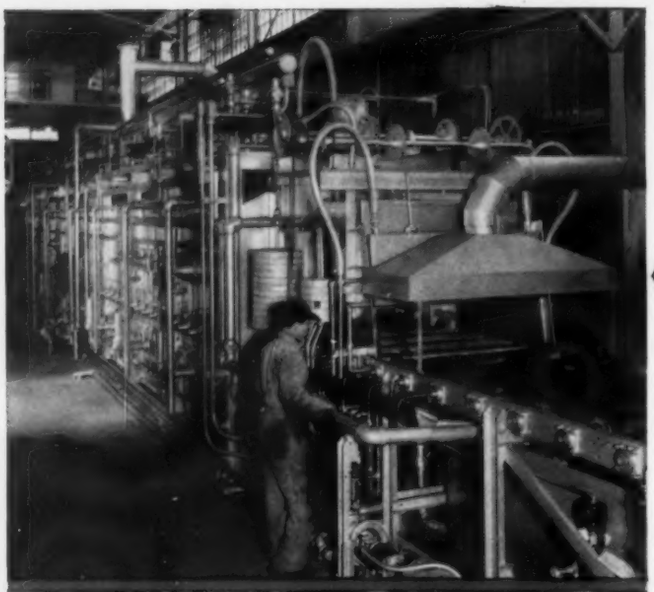
Now compare the two figures. Is it any wonder that every year more and more steel makers everywhere are switching to Lee Wilson Portable-Base Single-Stack Annealing Systems?

Lee Wilson

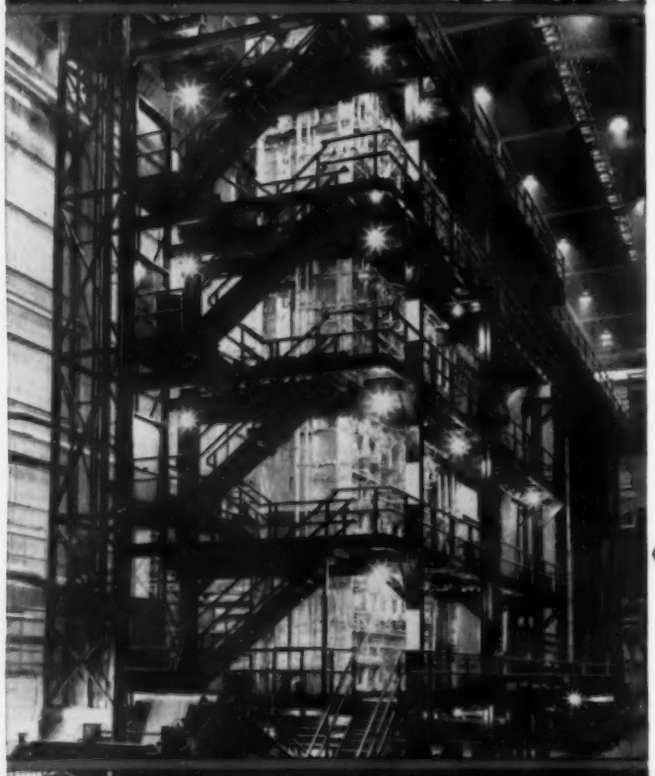
Engineering Company • Inc.

20005 West Lake Road • Cleveland 16, Ohio

BELL TYPE FURNACES • RADIANT TUBE HEATING • ANNEALING PROCESSES

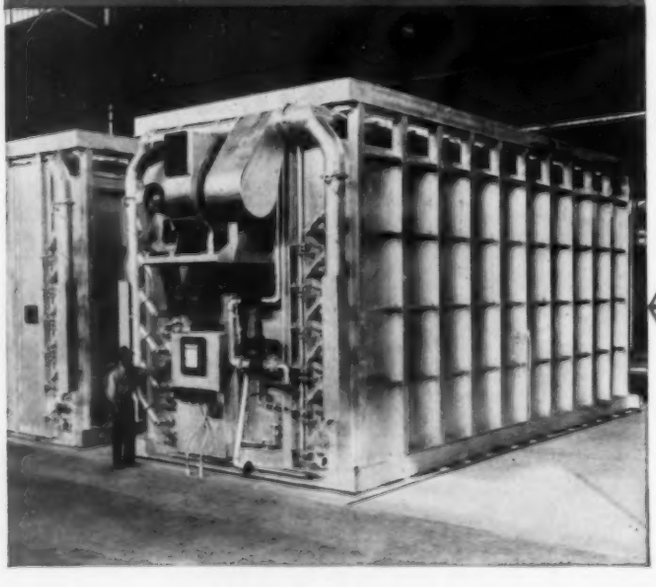


The first continuous carbon restoration annealing of steel was carried out in this Surface roller hearth furnace. Enriched RX atmosphere is the recarburizing medium; NX atmosphere is for surface protection.



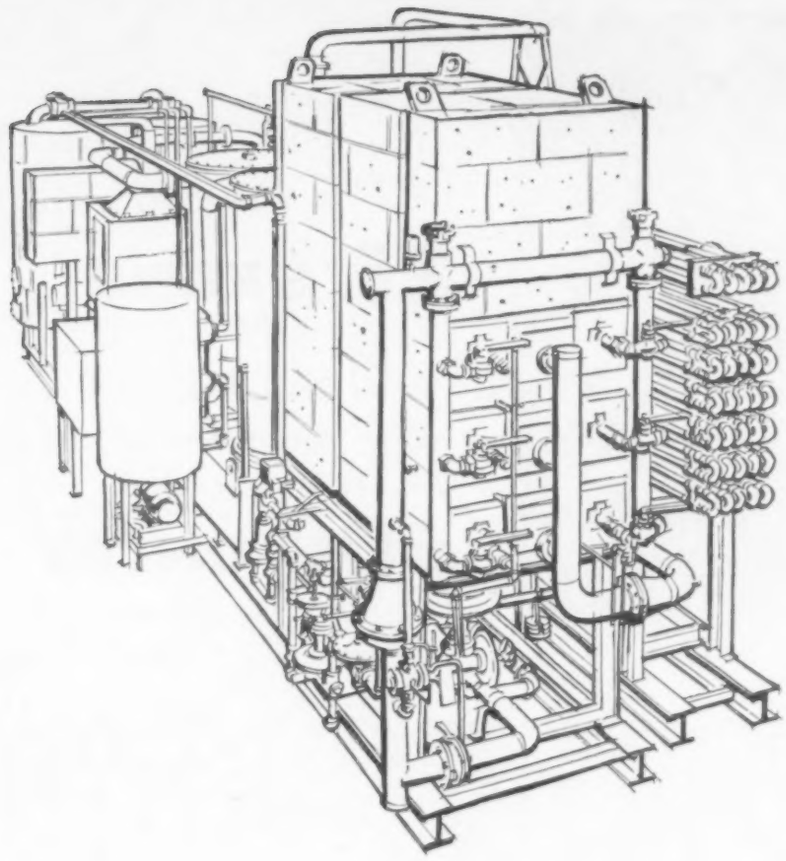
This is a Surface HNX Generator—one of the many types of generators which Surface Combustion supplies to help the industry deliver better finished steel.

SALES TOOLS



This vertical strand furnace is used for continuous bright annealing of strip for tin plating. Either NX or HNX gas can be used for the prepared atmosphere.

Batch bright annealing coiled strip is carried out in these lift type cover furnaces. This installation uses NX protective atmosphere.



ON THE MILL FLOOR

New markets open and customers are retained by developments on the mill floor. Steel surface quality, a major factor in customer acceptance, can be economically controlled through prepared atmospheres.

Many steelmakers have eliminated discoloration, "decarb," scale and other surface defects by using Surface Combustion prepared atmospheres. They have improved quality control, cut finishing costs by carbon correction and bright annealing, continuous or batch . . . clean hardening . . . clean annealing for galvanizing or tin plating.

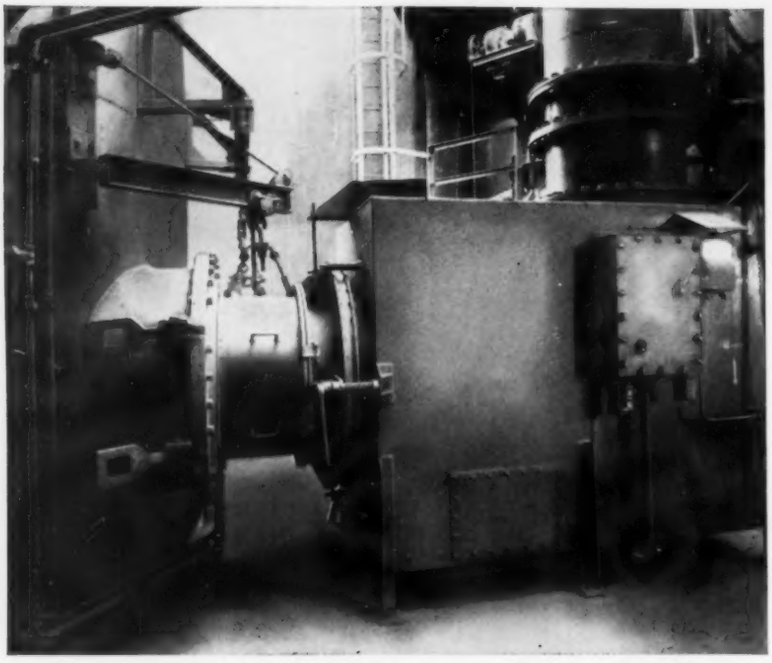
Their customers know that this steel means lower tool and die costs, fewer rejects—more steel, in effect, for their dollar.

'Surface' builds many types of atmosphere generators, including RX, DX, NX, HNX, and AX generators for the steel industry. Literature Group S53-3 will show you how to get the right atmosphere for satisfied customers and new markets.

Surface®
STEEL MILL FURNACES

SURFACE COMBUSTION CORPORATION • TOLEDO 1, OHIO

One-way fired soaking pits • Billet reheating furnaces • Slab heating furnaces • Continuous type, controlled atmosphere strip annealing and normalizing furnaces • Controlled atmosphere annealing covers for wire and rod • Controlled atmosphere annealing covers for coil and sheets • Continuous furnaces for heat treatment of steel plate • Controlled atmosphere furnaces for carbon correction in high alloy rod and bar stock • Continuous type bright annealing and normalizing furnaces • Prepared gas atmosphere generating equipment • Pit type convection furnaces for rod annealing • Stress relief furnaces • Wire patenting furnaces



The
Accumulated
Experience of

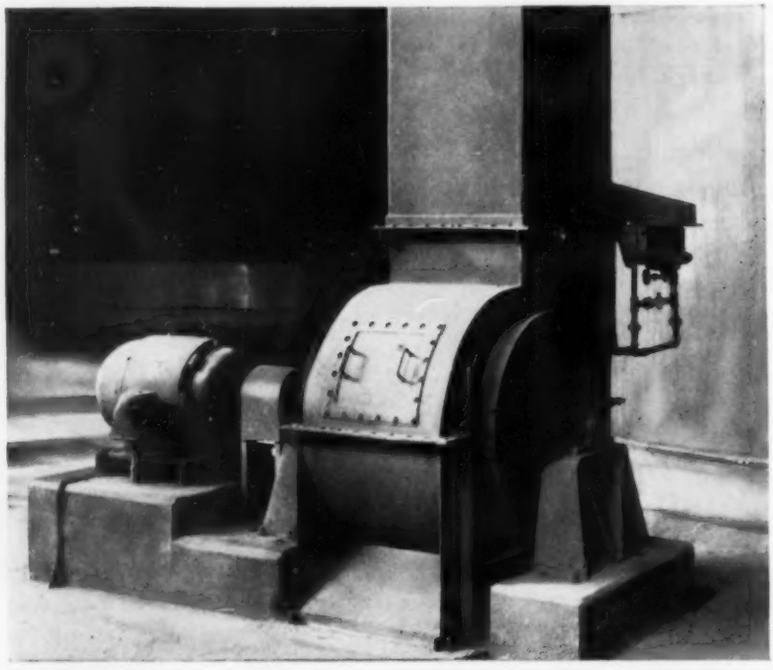
25 YEARS

IN THE DESIGN,
MANUFACTURE
AND INSTALLATION
OF OVER

500 UNITS

IS INCORPORATED
IN THE

Freyn-Design
BLAST FURNACE STOVE BURNER



*

AVAILABLE
IN CAPACITIES
FROM 8,000 TO
25,000 CFM GAS

*

TWO-THIRDS
OF SALES
HAVE BEEN
REPEAT
ORDERS

KOPPERS

METALLURGICAL PLANT DESIGN AND CONSTRUCTION

KOPPERS COMPANY, INC.

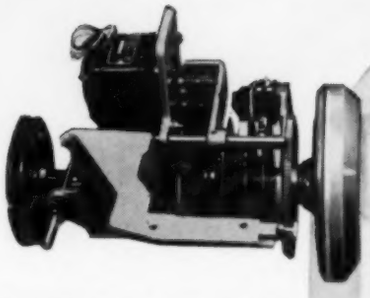
Freyn Engineering

Department

KOPPERS BUILDING • PITTSBURGH 19

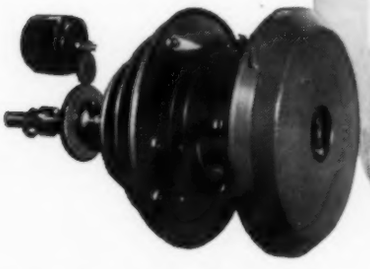
109 NORTH WABASH AVENUE • CHICAGO 2

Associated with Ashmore, Benson Pease & Co. Ltd., Stockton-on-Tees, ENGLAND
De Lattre & Freyard, Paris, FRANCE

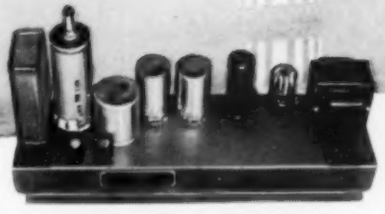


Reserve Power. Speedomax can operate at any speed from a whiz to a saunter, because balancing motors are two to four times more powerful than in any other present-day electronic controllers. A heavy load of control and signal cams makes no difference. The long Speedomax shaft and big case can accommodate a worlds-record assortment of such accessories.

Reserve Construction. You may think all instruments are "delicate", until you look at a Speedomax. Then you'll see forgings and castings instead of stampings; cut, heat-treated gears instead of cast; ball bearings instead of sleeves. You'll see aluminum used, to save weight; parts made extra-strong to prevent deflections. You'll see, in detail after detail, how rigid construction gives rigid dependability.



Locked-in Synchronism. Synchronization of control, recording and signalling actions is permanently fixed because their actuating cams are locked on a common shaft. Obvious? Yes, but in this field a Speedomax exclusive.



Reserve Sensitivity. A change of one tenth of one percent of the range is picked up by Speedomax. The instrument therefore, never strains to keep its readings precise, even when the range is short.

Reserve "Cleanness" Speedomax has superb filtering and (when needed) shielding, but neither can guarantee that the electronic recorder's circuit will be unaffected by electronic "junk" from nearby motors, or other equipment. So, we provide a unique "clean" circuit design—and thereby cancel the junk that would otherwise slow down the balancing motor. Net effect is snappy and accurate recording action.

SPEEDOMAX® "Reserves"

ARE ALWAYS ON THE JOB!

● You get extra-fine performance, day-in and day-out, from Speedomax Recorders or Controllers because they are full of reserves to meet the "unusual" conditions which can and do come up so frequently. And these reserves of course give low maintenance as well as fine performance.

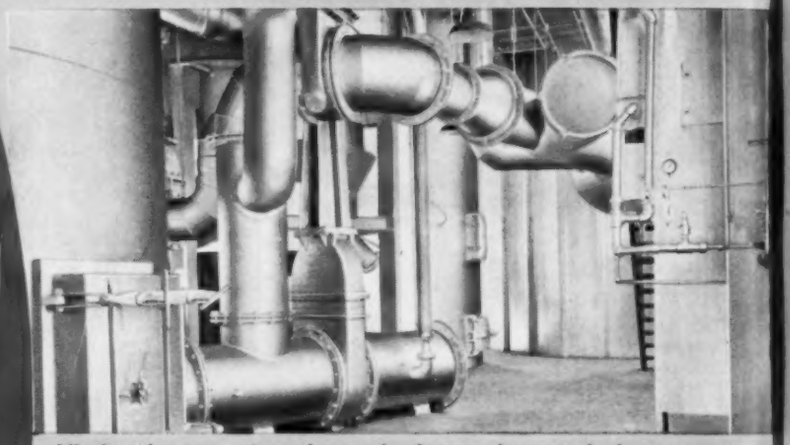
Why not inspect these evidences of quality the next time you need an automatic electronic potentiometer or bridge. See Catalog ND46(1) and (for circuitry) Tech. Pub. ND46(1). Address our nearest branch office, or 4942 Stenton Ave., Philadelphia 44, Pa.

LEEDS & NORTHRUP
instruments *automatic controls* • *furnaces*

Jrl. Ad. ND46(14)

A *complete* SERVICE FOR YOUR PIPELINE CONSTRUCTION PROJECTS

Here's how to take gas . . . across a ship canal. Piping bridge planned and erected by Semet with Semet-fabricated steel.

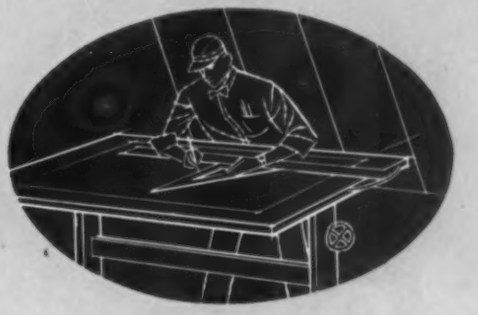


Vital to the operation of a synthesis gas plant are its low pressure arteries. This is a typical Semet-Solvay installation.

A network of process piping designed for use in conjunction with blast furnace operations.

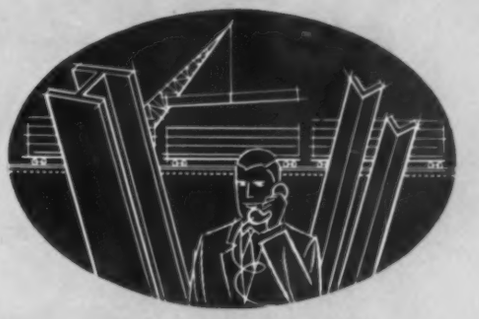
Up n'over, and distance is no object. An unusual "high road" for low pressure gas in an eastern steel plant.

SEMET-SOLVAY ENGINEERING DIVISION, Allied Chemical & Dye Corporation, is an integrated firm of engineers, manufacturers, and construction men. Unlike most other engineering firms, we have a combination of facilities that permit us to go beyond preliminary engineering, beyond construction alone. We handle complete pipeline construction projects from start to finish. We call them *"packaged unit"* pipeline programs. Here's how we would handle a job for you:



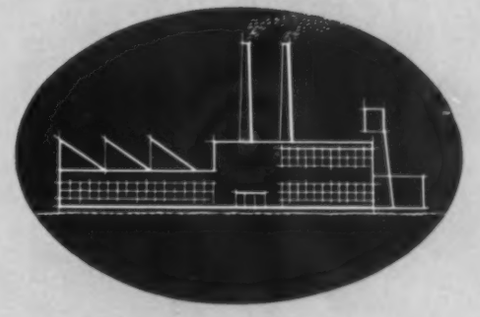
★ *INITIAL PLANNING*

in cooperation with your engineers, we would run surveys, propose layouts, provide detail drawings.



★ *COMPLETE PURCHASING*

we would free your staff from any worries about raw material procurement! Semet would purchase all necessary material, insure on-time delivery.



★ *FABRICATION TO SPECIFICATION*

our centrally located, completely equipped plant at Owosso, Michigan, is geared to produce manifolds, large fittings and piping. We fabricate our own standard and special valves—4" to 60"—for low pressure gas, air or steam systems up to 30 psig. We also fabricate whatever structural steel, bridgework, towers that may be necessary.

★ *INSTALLATION*

large plant, low pressure piping projects are our specialty . . . and our own construction men will provide a complete, ready-to-operate system to your most exacting requirements.

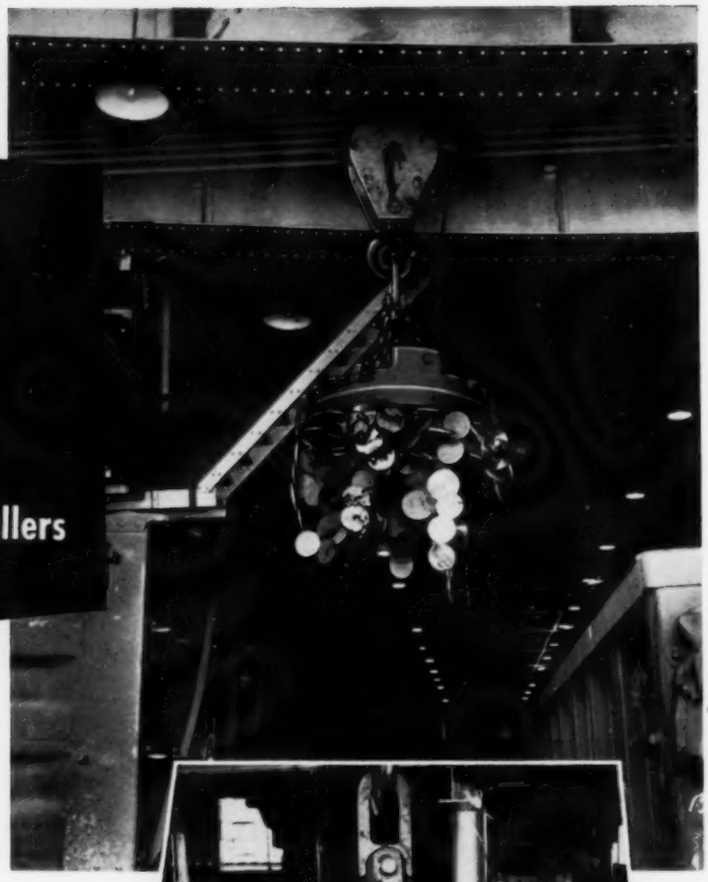
SEMET-SOLVAY ENGINEERING DIVISION

Allied Chemical & Dye Corporation

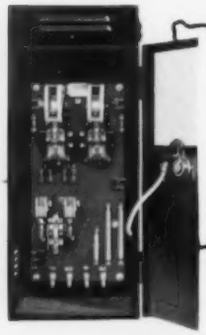
40 RECTOR STREET, NEW YORK 6, NEW YORK

Allied Chemical

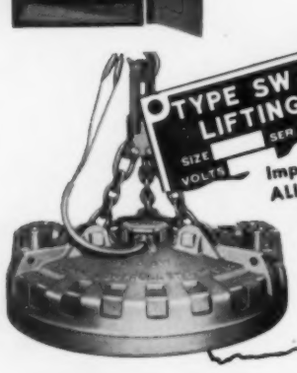
Raise the PROFIT level-
Cut the Discharge-time
with EC&M MAGNETS and
EC&M AUTO-DISCHARGE Controllers



Small Master Switch—convenient, compact and only 2 positions "Lift-Drop" simplify operator's motions.



Adjustable Controller—only EC&M Bulletin 905 Controllers have a dial permitting operator to adjust for fast, clean releases when voltage varies — material handled changes.



Improved Design Magnet—ALL-WELDED to keep pole shoes tight—keep moisture out—increase the efficiency of the magnetic circuit and prolong life.

55-inch diam. EC&M Type SW ALL-WELDED Magnet speeds handling of large diameter discs stamped from steel-plate.

WRITE FOR BULLETIN **900** *ON IMPROVED EC&M ALL-WELDED MAGNETS*

THE ELECTRIC CONTROLLER & MFG. CO.

2698 EAST 79TH STREET ★ CLEVELAND 4, OHIO

Easily Converted from 2-High to 3-High
NEW LEWIS MILL
Rolls Stainless Steel and Silicon

Installed for one of the nation's largest special steel producers, this new LEWIS Mill can be set up either for 2-High or 3-High operation. As a 2-High Mill, it rolls high-lustre stainless steel; when used on silicon steel, it operates as a 3-High Reduction Mill.

Every mill superintendent should investigate this 28" x 56" unit . . . its operation in your plant will mean more efficient and more profitable production.

Photograph courtesy Allegheny Ludlum Steel Corporation

BLAW-KNOX COMPANY
LEWIS MACHINERY DIVISION
PITTSBURGH 22
PENNSYLVANIA

BLAW-KNOX

Dave O'Leary, Shop Superintendent, and Joe Koehn, Fitting Shop Foreman, look over a blueprint in the Heyl & Patterson Fitting Shop. Both men are 30-year veterans with Heyl & Patterson.

"Old Pros" with the "FOLLOW THROUGH" that counts!

The "Follow-Through" is one of the many ingredients that contributes to the successful performance records of Heyl & Patterson designed, fabricated and erected equipment.

Here is a picture snapped in the Heyl & Patterson Fitting Department. It's a "natural" showing how our shop men "follow-through" from the original designs of our Engineering Department. Compare the picture of these "Old Pros" with the "Follow-Throughs" you have seen on TV in batting scenes from the World Series in baseball and the important winning forward passes in pro-football games. The Heyl & Patterson "follow-through" is possible because we have our own Engineering Department, our own Fabricating Department, our own Machine Shop, our own Erection Department.

The H & P Engineering Department calls the signals and the other H & P Departments know how to "Follow-Through." This is why Heyl & Patterson can guarantee long-life, low-cost performance of Heavy Bulk Materials Handling Equipment.

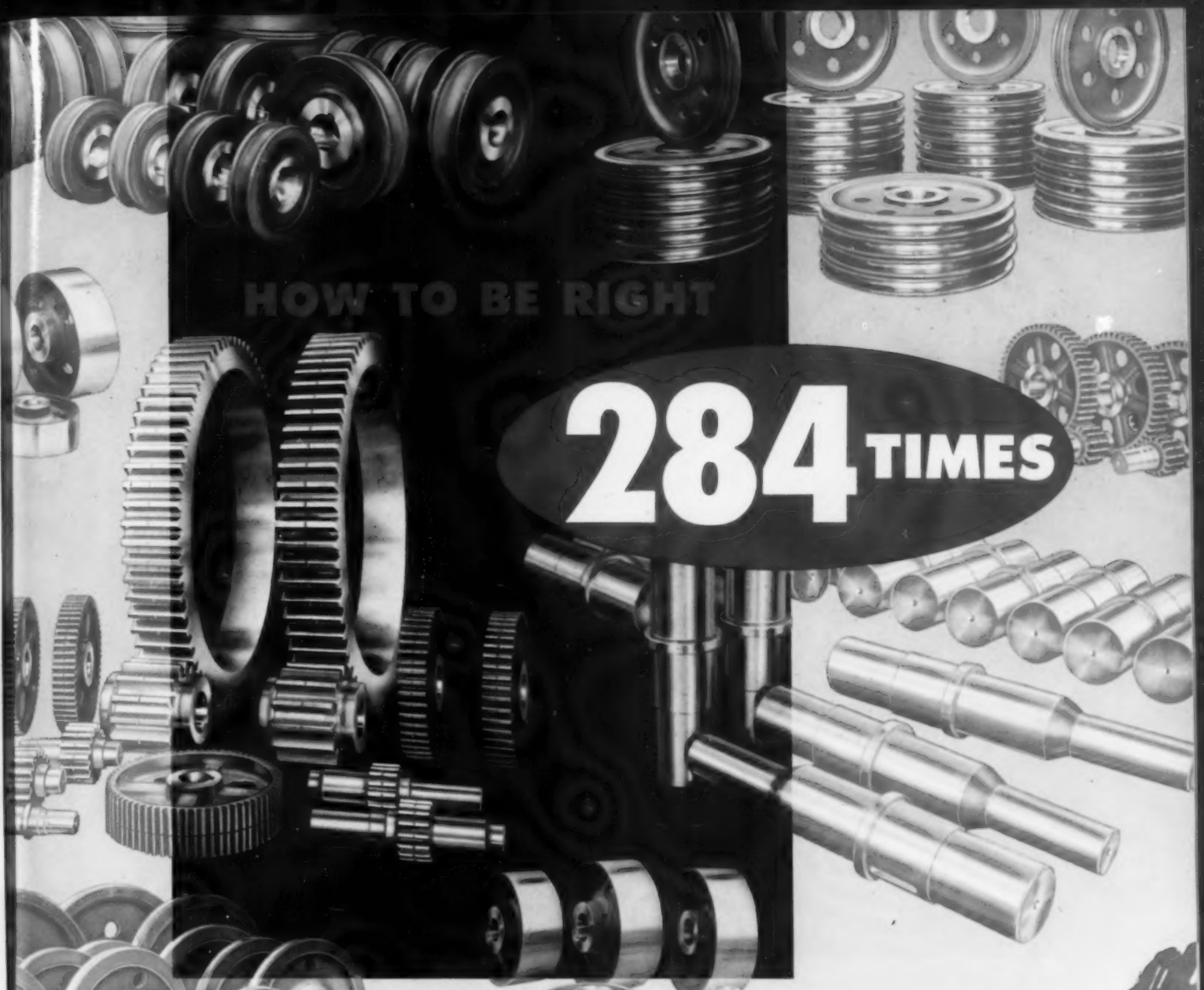
Heyl + Patterson, Inc.

"SINCE 1887"

Heavy Bulk Materials Handling Equipment

All The Way from Design to Erection

55 WATER STREET · PITTSBURGH 22, PA.



A large mid-west steel company with a reputation for making right decisions installed 284 Tool Steel Process parts on two new ladle cranes.

Substantial operating-maintenance savings previously experienced with Tool Steel Process parts was their reason. They found as others have, for extra long life, Tool Steel Process hardened parts are unequalled. On the two cranes the company specified:

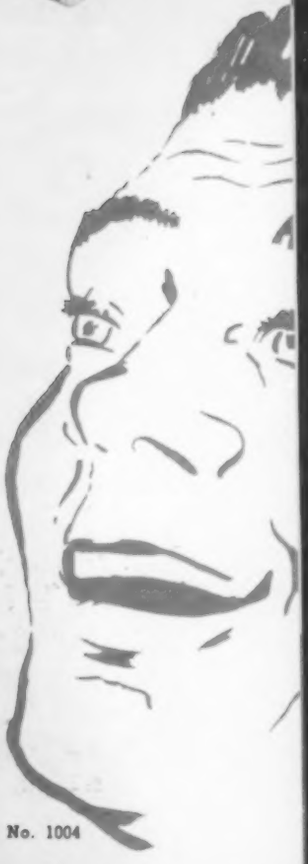
32 AXLES • 60 GEARS - PINIONS • 192 WHEELS (sheave, track, brake)

TSP ... products are hardened by our special process. The file hard surface to the full depth of permissible wear gives maximum wear. The core, refined for toughness and ductility, gives maximum strength.

You receive an absolutely positive written guarantee that TSP products will give a longer life in the same service than any other product.

THE TOOL STEEL GEAR AND PINION CO
CINCINNATI 16, OHIO, U. S. A.

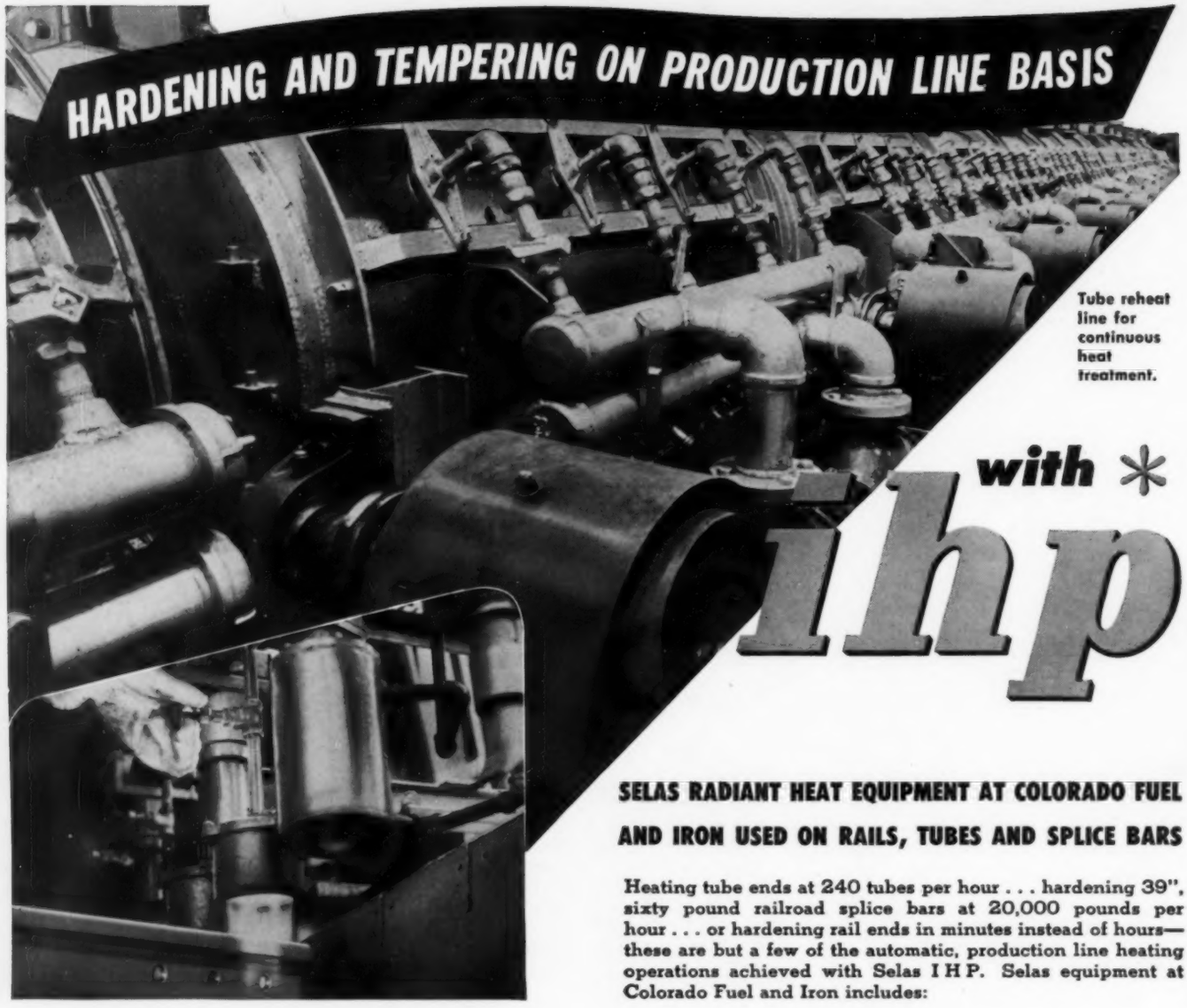
Write today for Bulletin 252.



Ad No. 1004

The Standard of Quality Since 1909 for Gears • Pinions • Rolls • Wheels and Other Hardened Products

HARDENING AND TEMPERING ON PRODUCTION LINE BASIS



Tube reheat line for continuous heat treatment.

with * ihp

Burners positioned over rail ends to be hardened.

Furnace in operation for heat treatment of railroad splice bars.

SELAS RADIANT HEAT EQUIPMENT AT COLORADO FUEL AND IRON USED ON RAILS, TUBES AND SPLICE BARS

Heating tube ends at 240 tubes per hour . . . hardening 39", sixty pound railroad splice bars at 20,000 pounds per hour . . . or hardening rail ends in minutes instead of hours—these are but a few of the automatic, production line heating operations achieved with Selas I H P. Selas equipment at Colorado Fuel and Iron includes:

- Rail-end hardening burner line
- Railroad splice bar hardening furnace
- Tube end heating furnaces for upsetting (2 units)
- Tube reheat line (18 Gradiation furnace units)
- Tube tempering line (8 Gradiation furnace units)
- Tube hardening line (8 Gradiation furnace units)

In these plants as in other metal working plants throughout the nation, Selas I H P speeds heat treating, assures precise uniformity in every piece, improves production, cuts fuel costs.

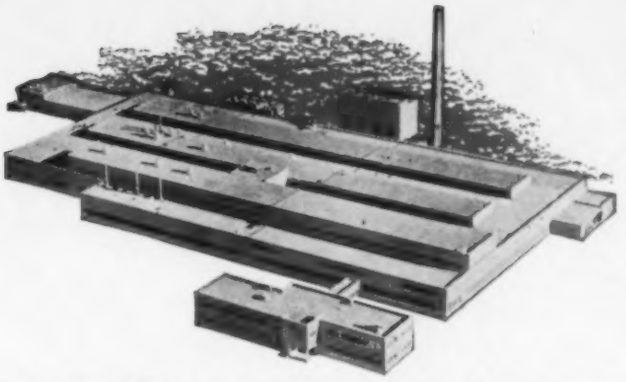
I H P is not a machine . . . not a furnace . . . not a method of heat treating, but a combination of Selas techniques and equipment using gas as a heating medium. Prove the savings possible in your plant with I H P. Write for the new booklet describing Selas Radiant Heat for metal working.

*Improved Heat Processing

SELAS

CORPORATION OF AMERICA
PHILADELPHIA 34, PENNSYLVANIA

Heat Processing Engineers for Industry • Development • Design • Manufacture



N-B-M Meadville . . . where the welcome mat is out. We're proud of this plant—its equipment and the skilled people who work in it. Proud enough, in fact, to offer a standing invitation to Blast Furnace Superintendents or other steel mill officials to visit us. When can *you* make an inspection trip?

These CASTINGS have "RUN THE GAUNTLET"

Here's where you'll find copper castings that have been subjected to rigid tests for soundness and quality.

Another Reason why N-B-M Meadville is a name to remember when you specify copper castings. What does your eye tell you when you see this picture? Chances are, "a big selection of copper castings". And, it's true that this big selection is typical of the wide range of copper castings that N-B-M Meadville is equipped to produce.

But, there's something more important that no ordinary photograph can show . . . because each of these castings has its own "success story". Each has been subjected to the most painstaking system of production and quality control that you'll find in any foundry . . . anywhere. That's why we say that castings reaching our shipping room have "run the gauntlet" . . . *we know they're right.*

From the molding floor to the shipping room, N-B-M Meadville accomplishes what should be, and is, the main objective of this modern, well-manned plant . . . ***what you specify . . . we ship.***

AMERICAN Brake Shoe COMPANY

NATIONAL BEARING DIVISION

4936 Manchester Avenue • St. Louis 10, Mo.

PLANTS IN: ST. LOUIS, MO • MEADVILLE, PA. • NILES, OHIO • PORTSMOUTH, VA. • ST. PAUL, MINN. • CHICAGO, ILL.

F&Y

ROCKER AND SLIDE TYPES
FOR CUTTING

BILLETS • RAILS
ROUNDS • TUBING
SQUARES • STRUCTURALS
SPECIAL SHAPES

The Youngstown Foundry & Machine Co.
OVER SIXTY YEARS OF SERVICE TO THE STEEL INDUSTRY
Youngstown, Ohio

14

By MELVIN NORD, Patent Attorney, Detroit, Mich.

Patent Reviews

. . . . copies of patents may be obtained from the Commissioner of Patents, Washington 25, D. C., at 25 cents each . . . . patents reviewed cover period July 14 through August 4, 1953 . . . .

MULTIPLE ROLLING OF STRIP

▲IN the rolling of strip metal in single ply in a continuous mill, the ratio of the width to the thickness of the finished product very rarely exceeds 1000:1, and in fact the cost of rolling strip in this manner mounts rapidly when the width to thickness ratio of the finished product exceeds 200:1. The higher costs of production are a result of greater power consumption, roll deterioration, damage to equipment on account of excessive torque loads, and the necessity for precision control of slab heating and rolling temperatures. Practical limitations in single ply hot rolling of typical steels on modern continuous hot strip mills are shown in Table I, where T is thickness in inches and W is width in inches.

TABLE I

W, in.	Mild carbon		Low alloy		Austenitic stainless	
	T	W/T	T	W/T	T	W/T
30	0.038	790	0.060	500	0.070	428
40	0.038	1050	0.070	570	0.100	400
50	0.048	1040	0.075	667	0.130	384
60	0.058	1032	0.080	750	*	*
70	0.068	1030	0.100	700	*	*
80	0.078	1025	0.100	800	*	*

* Cannot be rolled economically.

In addition to the limitation in W/T ratio of the strip produced by single ply continuous hot rolling, this method has the further disadvantage that the surface produced is far from perfect, due to the oxide and scale rolled into it. It has been necessary, therefore, to give the rolled strip a further finishing treatment to remove the scale and to smooth the surface.

In U.S. 2,645,842, issued July 21, 1953 to Howard S. Orr and assigned to United States Steel Corp., a method is disclosed for multiple rolling in continuous hot strip mills, in which the W/T ratio may be as great as 10,000:1, without excess strain on the rolls, and with practically no surface scale or defects.

Figure 1 is a perspective view of a pack of plates to be rolled as a unit slab. It consists of a top sheet 6 and a bottom sheet 4 of easily hot rollable metal, such as mild steel. In between are sheets of difficulty rollable steel; these are somewhat narrower and shorter than the cover sheets. Between each sheet is placed a separating material, to prevent welding of adjacent sheets together. Side bars 14 and end bars 12 are welded to the outer edge of the cover sheets. Access of the interior of the slab to the atmosphere is maintained by means of openings 16 in the end bars 12. The total thickness of the inner plates compared to cover plates is generally between 1:1 and 2:1, but may be as high as 5:1.

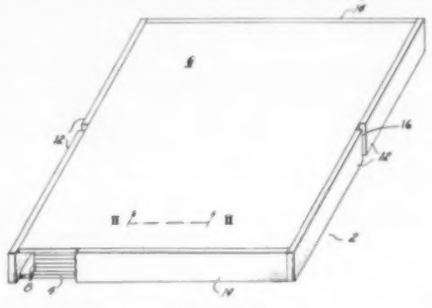


Figure 1

The separating layers between sheets may be natural oxide or scale from previous heating and rolling, or preferably, of finely divided magnesia applied to the surfaces as a slurry in water.

Table II shows the results of rolling a typical slab of the type described.

PROCESS OF MANUFACTURING BASIC STEEL

U.S. 2,646,351, issued July 21, 1953 to Karl Heimberg and assigned to Compagnie Generale des Conduites d'Eau, relates to a process for making basic or Thomas steel by charging a remelted pig iron into a Thomas converter.

The pig iron charged to the converter has the following composition: 3.5-3.8 per cent C, 0.2-0.5 per cent Si, 0.8-1.2 per cent Mn, 1.7-1.9 per cent P, and 0.04-0.06 per cent S. It is obtained from low grade pig iron and/or steel turnings by adding thereto an excess of coke and subjecting the mixture to a hot blast at a minimum of 400 C in a neutral or basic cupola

TABLE II

Sheet	Material	Thickness (in.)		W/T	Reduction ratio
		Original	Final		
Cover	0.08 per cent C steel	1.250	0.076	486	16.4
1st	17 per cent Cr	0.250	0.016	2120	15.6
2nd	18 per cent Cr, 8 per cent Ni	0.490	0.031	1095	15.8
3rd	18 per cent Cr, 8 per cent Ni	0.190	0.012	2830	15.8
4th	18 per cent Cr, 8 per cent Ni	0.078	0.005	6800	15.6
5th	17 per cent Cr	0.250	0.016	2120	15.6
Bottom	0.08 per cent C steel	1.250	0.076	486	16.4

run with a reducing blast, while generating gases with the formation of a relatively large quantity of basic slag. The resultant basic or Thomas pig iron has a pouring temperature of 1500-1600 C, and a working temperature of 1400-1500 C. This high-temperature fluid pig iron is charged into a Thomas converter and refined into basic steel.

SINTERING MACHINE

Improvements in sintering machines of the type used for aggregating fine iron ore or flue dust are provided in U.S. 2,647,615. The patent was issued August 4, 1953 and assigned to National Steel Corp. The inventor, Martin L. Cover, states that his invention makes it possible to operate a sintering machine with the pallets moving along the rails in such a manner that there is no objectionable crowding or canting of the pallets which causes excessive wear and abrasion. Details of the sprocket for lifting the pallets from the lower rails to the upper rails and for pushing the pallets along the upper rails are given in the patent specification.

PROCESS OF TIGHT COAT HOT DIP GALVANIZING

In U. S. 2,647,305, issued August 4, 1953 to Nelson E. Cook and Samuel L. Norteman, assigned to Wheeling Steel Corp., uniform optimum tight coatings are obtained without mechanical stirring, through the use of electric induction heating. The resulting thermal circulation maintains the molten metal relatively uniform, and prevents the aluminum from settling

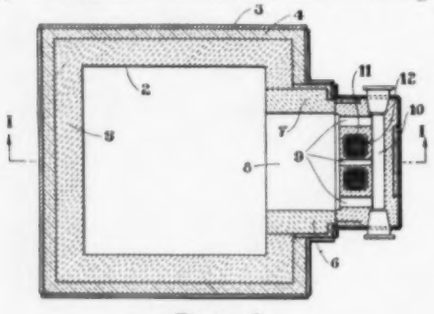


Figure 2

out of the bath. Another advantage of electric induction heating is the speed of melting and distributing additional aluminum which must be added from time to time.

One form of the invention is shown in Figures 2 and 3. The galvanizing pot 2 consists of an outer steel shell 3, a lining of 4 of insulating material, and a refractory inner lining 5 for the molten bath. An extension 6 extends laterally and downwardly from a side of the pot. A passage 8 in this extension communicates with three downwardly and outwardly directed ducts 9 which eventually enter a cross duct 10. A magnetic core 11 and a coil 12 are disposed in a closed loop about the central one of the three ducts 9. A low voltage is induced across the ducts 9. Since the ducts 9 and 10 form a closed circuit, a current will flow in them. The current generates heat in the metal itself, thereby maintaining the bath molten.

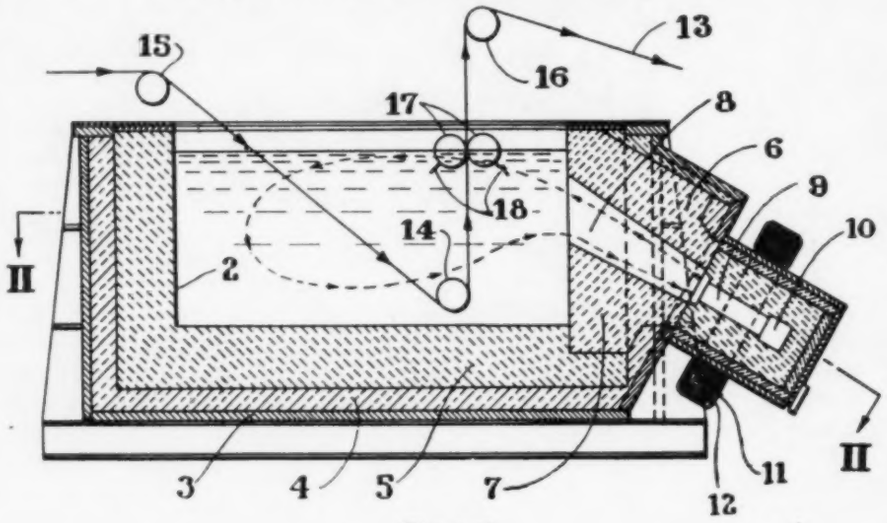


Figure 3

A steel strip 13 is guided so that it can be drawn continuously through the molten coating bath in the pot. A guide roll 14 is disposed beneath the surface of the molten coating bath, while other guide rolls 15 and 16 are above the galvanizing apparatus.

OTHER PATENTS OF INTEREST TO THE IRON AND STEEL ENGINEER

Patent No.	Date	Subject	Inventor or Assignee
2,645,000	7/14/53	Tool for finishing tube ends	Jones & Laughlin Steel Corp.
2,645,138	7/14/53	Drill bit forging machine	Albert W. Mitchhart
2,645,164	7/14/53	Deburring and swaging mandrel for interior wall of tubing	The Standard Tube Co.
2,645,558	7/14/53	Lining for centrifugal iron casting molds	Josef Burchartz
2,645,559	7/14/53	Production of ammonium sulphate from coke-oven gas	Carl Otto
2,645,560			
2,645,574	7/15/53	Steel for high-temperature use	The Timken Roller Bearing Co.
2,645,955	7/21/53	Outboard bearing for metal rolling apparatus	The National Machinery Co.
2,646,068	7/21/53	Apparatus for dispensing a measured quantity of pickling acid	National Steel Corp.
2,646,103	7/21/53	Universal rolling mill	Joseph D. Kiss
2,646,231	7/21/53	Hot strip furnace reel	Ferdinand Frielinghaus
2,646,263	7/21/53	Smoke and spark arrestor for cupolas	Modern Equipment Co.
2,646,267	7/21/53	Retort for heating the edge of skelp in the manufacture of welded pipe or tubing	Air Reduction Co., Inc.
2,646,278	7/21/53	Pass-line stabilizer for strip approaching a shear	United States Steel Corp.
2,646,345	7/21/53	Ammonia saturator and tar removal apparatus	Carl Otto
2,646,352	7/21/53	Alloy steel products	Armco Steel Corp.
2,646,375	7/21/53	Process for hardening alloy gray cast iron	The International Nickel Co.
2,646,395	7/21/53	Coke-oven charging car	Grady Padgett
2,646,651	7/28/53	Hydraulic roll grinder	Blaw-Knox Co.
2,646,746	7/28/53	Control system for billet marking	United States Steel Corp.
2,646,900	7/28/53	Stockline control in a pellet-indurating stack furnace	Erie Mining Co.
2,647,421	8/ 4/53	Upsetting forging machine	The Ajax Manufacturing Co.
2,647,483	8/ 4/53	Metal forming and welding machine	William E. Price
2,647,784	8/ 4/53	Die set handling flange and coacting hook	Superior Steel Products Corp.
2,647,981	8/ 4/53	Electrical butt-seam welding process for manufacturing tubes	Alfred Wogerbauer
2,647,982	8/ 4/53	Manufacture of seam welded tubes	Westinghouse Electric Co.

MORE high carbon spring steel with LESS passes on BLISS 4-High Mill!

Combines with BLISS SLITTING MACHINE to cut costs for Athenia Steel

PROBLEM: The Athenia Steel Division of National Standard Company specializes in highest quality, "custom-made" steel. This high carbon steel is used for such precision parts as piston rings, band saws, watch and clock springs, feeler gages and razor blades. Hence, when seeking to increase production through heavier rolling mill equipment at their Clifton, New Jersey, plant, Athenia specified there must be no sacrifice in the quality of their product.

SOLUTION: Athenia installed a new Bliss 10" & 24" x 20" four-high mill and a Bliss slitting line. Formerly, Athenia's mills could produce steel in widths up to 6½". The new Bliss mill enables them to roll widths of 16½" and achieve greater reductions with each pass. These wider strips are then cut into required widths on the Bliss slitting line. *Faster production and lower costs result—at the same high quality level.*

Athenia uses the Bliss mill for breakdown and finishing work. Its effective range is for reductions from 0.125, 0.105 and 0.095 down to 0.015. Officials at Athenia particularly like the mill feature that permits coil "take-off" on either side. They also like the "automatic clamp and sticking device" for entering the metal in the rolls. And they were pleased with the reliable, smooth-starting mechanical and electrical equipment supplied by Bliss.

Whatever your rolling mill problem—large or small, routine or intricate—call Bliss' Rolling Mill Division. Their engineers will be glad to help you. But, today, send for your copy of the revised Bliss Rolling Mill Brochure, soon off the press; it describes Bliss' products and services and contains many valuable production ideas.

9" x 18" BLISS SLITTING LINE cuts high carbon rolled steel into multiple strips of desired width to speed production, and afford full range of selection.

Remember: BLISS **for Presses, ROLLING MILLS, Special Machinery**

E. W. Bliss Company • General Office: Canton, Ohio

ROLLING MILL DIVISION: SALEM, OHIO

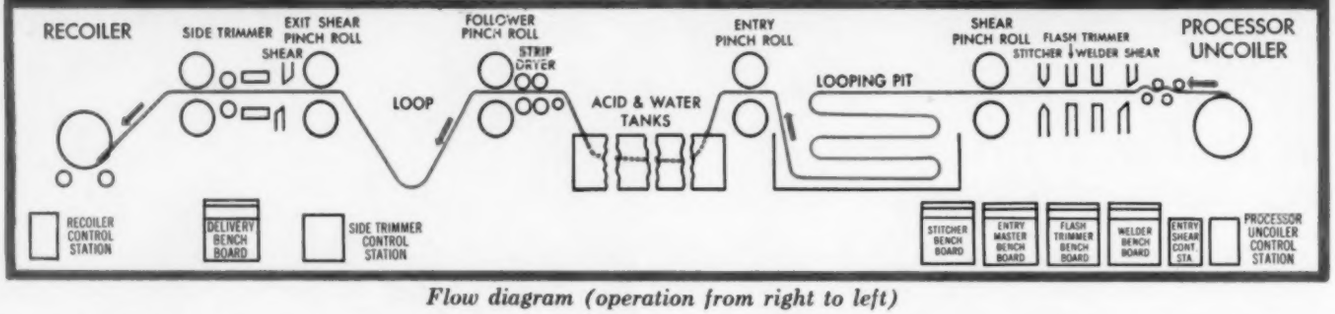
E. W. Bliss (England) Ltd., Derby, England • E. W. Bliss Company (Paris), St. Ouen sur Seine, France

U. S. Plants in Canton, Salem and Toledo, Ohio; and Hastings, Michigan. Branch Offices in Chicago, Cleveland, Dayton, Detroit, Indianapolis, New Haven, New York, Philadelphia, Rochester, Toledo and Toronto, Canada. West Coast Representatives: Moore Machinery Co., Los Angeles and San Francisco; Star Machinery Company, Seattle. Other representatives throughout the world.

Continuous Pickling Line at Pittsburgh Steel is CLARK Controlled

Exit section seen from recoiler

Entry section seen from processor uncoiler



Flow diagram (operation from right to left)

This Wean Engineering Co. continuous pickling line at the Pittsburgh Steel Co.'s Allenport, Pa. mill is powered by 7 DC strip-drive motors and 39 AC auxiliary motors totaling 1409 HP—all efficiently controlled by Clark apparatus.

Designed for a normal operating speed of 500 FPM, this 60 inch combination pickling and side trimming line consists of three sections. The entry section includes the processor uncoiler, shear, welder, flash trimmer, stitcher, and shear pinch roll. The center section includes the entry pinch roll, acid and water tanks, strip dryer and follower pinch roll. The delivery section includes the exit shear pinch roll, shear, side trimmer and recoiler. The control system employs current limit and voltage regulation in all three sections to provide for the most efficient utilization of the available horsepower.

CLARK engineered controls for processing lines are the cumulative result of years of engineering experience. These controls embody the latest circuit designs and devices and are continually being improved to keep pace with production and safety requirements as determined by modern mill practice.

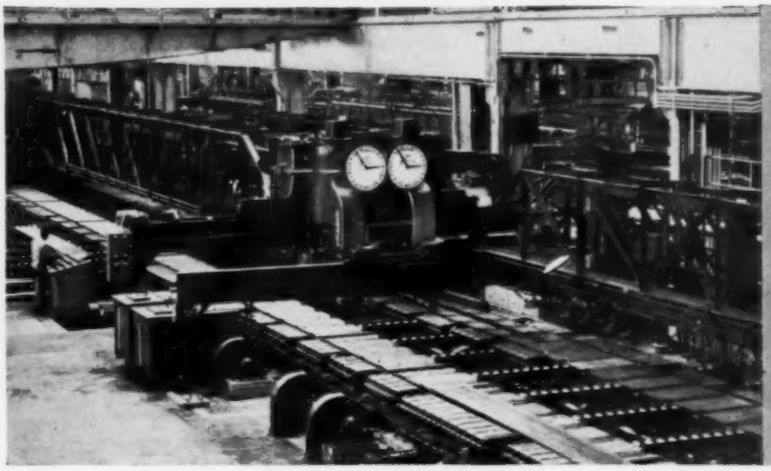
For all types of Processing Lines CLARK engineering "know-how" provides you with dependable, complete control. Consult our nearest District Office for details.

CLARK *Control Panel for Center and Exit Sections*

ENGINEERED ELECTRICAL CONTROL

THE CLARK CONTROLLER CO.

1146 EAST 152ND STREET, CLEVELAND 10, OHIO



In this breakdown mill installation, cold brass bars 2200 lbs. in weight are reduced in a series of passes from 2½" to .400". Nearly 1,500,000 lbs. of metal can be rolled during an eight-hour shift, the rolling operation and all handling equipment being completely controlled by two operators, each at a control desk on either side of the 30" x 36" mill. Suction cup pilers and unpilers, hydraulically operated, move the bars from point to point. Stacks of bars are returned for the succeeding pass or transported to the annealing oven by chain transfer.

Careful Planning Increases Profits

IN ROLLING NONFERROUS METALS

For many years Farrel-Birmingham has specialized in the development of complete layouts for rolling nonferrous metals. Designed for specific sets of conditions, these installations are planned to increase profits through continuous or semi-continuous production, with a minimum of manual handling.

We are prepared to design and build the mills, reduction gear drives, pinion stands, coilers and special handling equipment required to form a complete, integrated unit. Mills are built in a wide variety of types and sizes for rolling nonferrous rods, strips, sheets, foils, and cold strip steel.

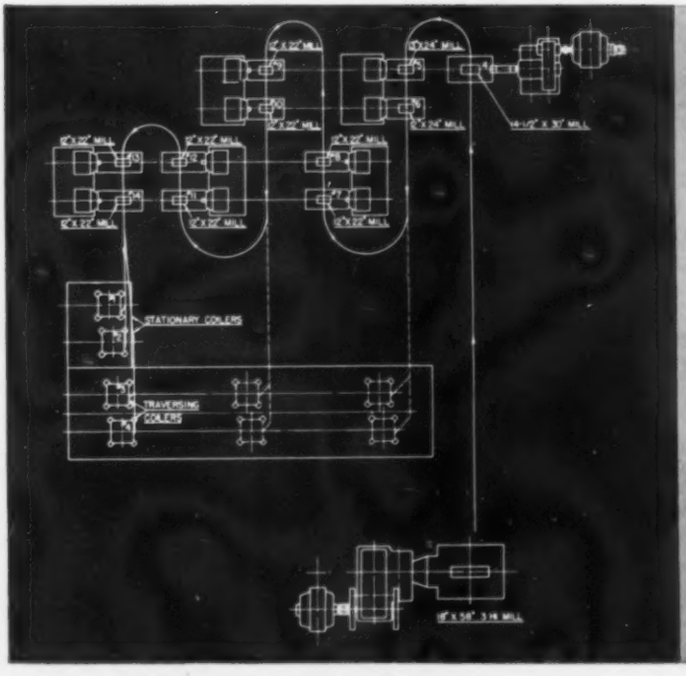
Write for quotations on mills for specific applications or for complete layouts designed to suit your individual needs.

FOR EXAMPLE

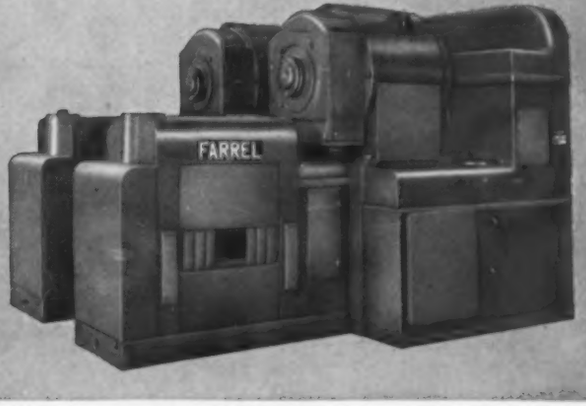
FARREL-BIRMINGHAM COMPANY, INC., ANSONIA, CONN.
Plants: Ansonia, Conn., Derby, Conn., Buffalo, N. Y.
Sales Offices: Ansonia, Buffalo, New York, Akron,
Chicago, Los Angeles, Houston

FB-821

Farrel-Birmingham ®



Layout of hot copper rod rolling mill, consisting of five tandems of two mills each, coilers and breakdown mill. Engineered by Farrel-Birmingham, this entire setup is fully automatic, requiring no operators on the floor. The flow of material is uninterrupted from billet breakdown to final pass.

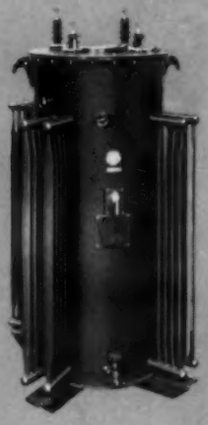


POLE STAR DISTRIBUTION TRANSFORMERS

Pole Star Distribution Transformers — 3 Kva through 500 Kva, 2400 through 67,000 volts

Protected Pole Star (CSP® Transformers) 3 Kva through 100 Kva 2400 through 14,400 volts

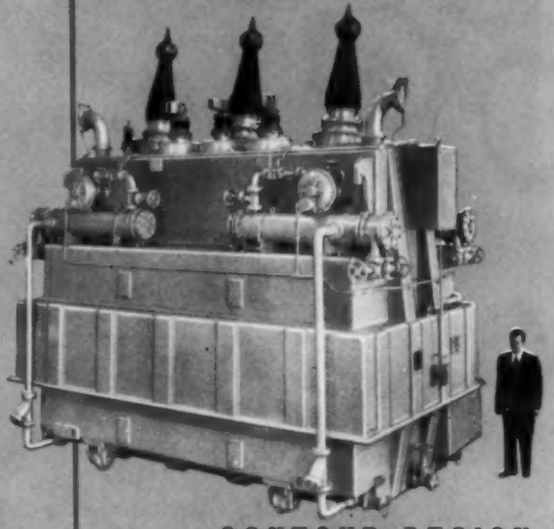
5 Kva Pole Star 2400/4160Y — 120/240 volts



500 Kva Pole Star 13,200 — 2400/4160Y volts

105,000 Kva, Three-phase

115,000 Grd. Y — 13,200 Delta volts

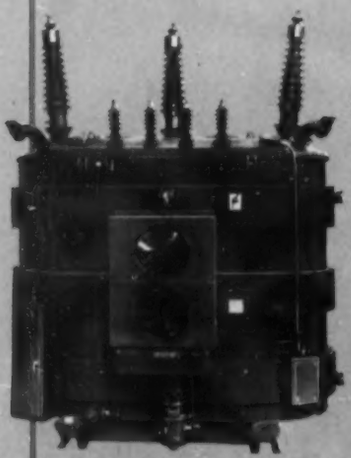


CONTOUR DESIGN

TRANSFORMERS...

PENNSYLVANIA TRANSFORMER COMPANY'S ONLY PRODUCT

CORE FORM POWER TRANSFORMERS



138,000 Volts

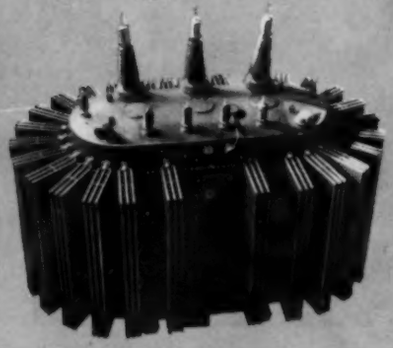
37,500 Kva, Three-phase 132,000 Grd. Y — 24,000Y/13,860 — 6900 Delta volts

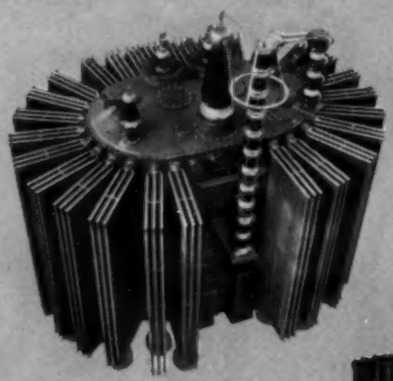
132,000 Volts

20,000 Kva, Three-phase, 132,000 Delta — 26,400Y/15,240 volts

161,000 Volts

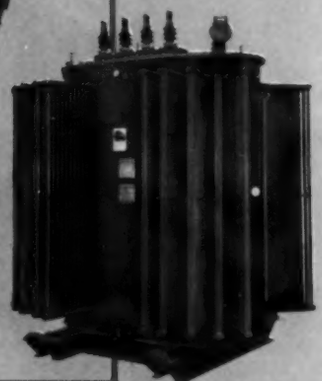
56,000/70,000 Kva, Single-phase. 93,000/161,000 Grd. Y — 19,000 volts

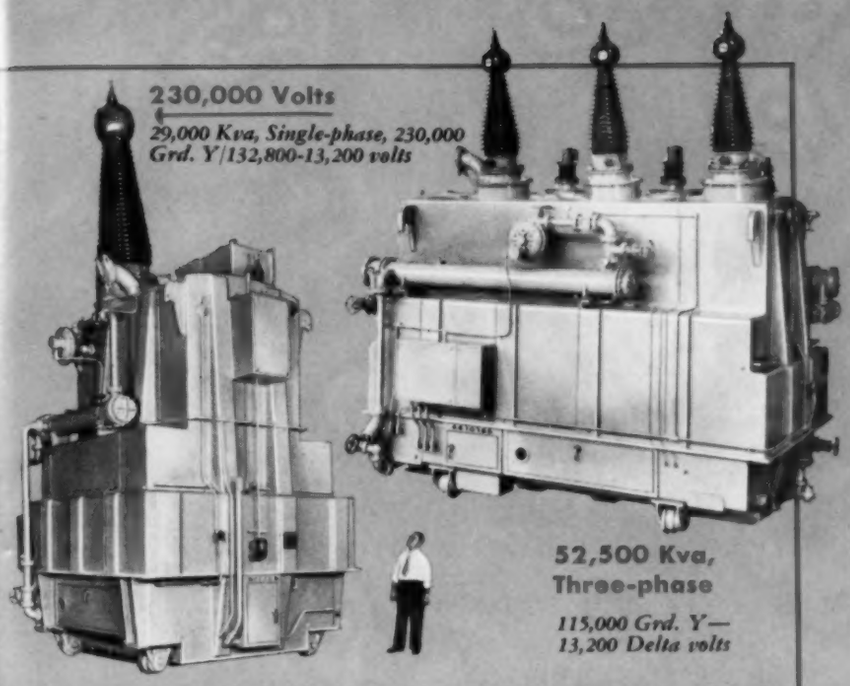




STANDARD PARTS POWER TRANSFORMERS

Three-phase: Up to 10,000 Kva, 34 Kv
Single-phase: Up to 5,000 Kva, 34 Kv





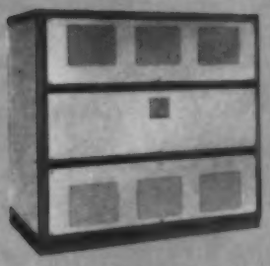
230,000 Volts

29,000 Kva, Single-phase, 230,000 Grd. Y/132,800-13,200 volts

52,500 Kva, Three-phase

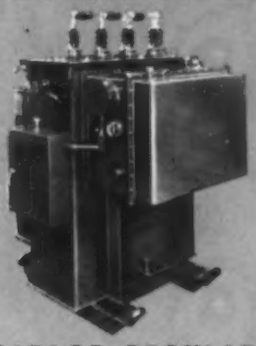
115,000 Grd. Y— 13,200 Delta volts

SHELL FORM POWER TRANSFORMERS



DRY TYPE

Sealed, Ventilated and Forced-Air-Cooled



STEP VOLTAGE REGULATORS

Up to 750 Kva for plus or minus 10% regulation in 32 steps

DISTRIBUTION TRANSFORMERS

3 Kva through 500 Kva
Up to 67,000 volts

POWER TRANSFORMERS

750 Kva to 250,000 Kva
Up to 330,000 volts

For 24 years, we have concentrated on designing and manufacturing one product — transformers. Each year we do more business than the previous year, and each year we keep bettering our product. We count among our customers the finest Utilities and Industrials in the country. We believe that if you are interested in transformers, you'll want to investigate Pennsylvania. We invite you to contact us.

PENNSYLVANIA TRANSFORMER COMPANY

A McGraw Electric Company Division

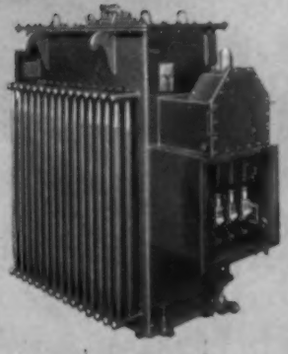
CANONSBURG, PA. *Greater Pittsburgh District*

ASKAREL

Non-inflammable, liquid-filled Distribution and Power Sizes

NETWORK

300 through 1,000 Kva. 2400 through 34,400 volts

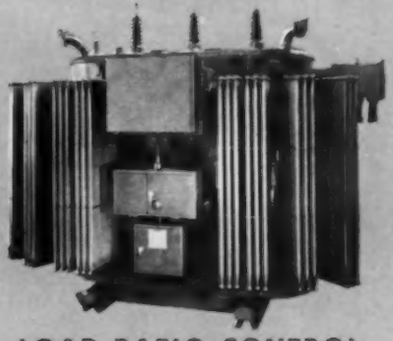


UNIT SUBSTATION

Single-Circuit and Duplex Unit Substations

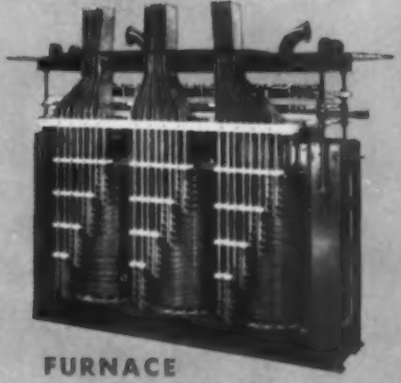
SUBWAY

Submersible Type, Single and Three-phase



LOAD RATIO CONTROL

For changing transformer taps under load in sizes up to 50,000 Kva



FURNACE

For operating Electric Arc Furnaces of any tonnage

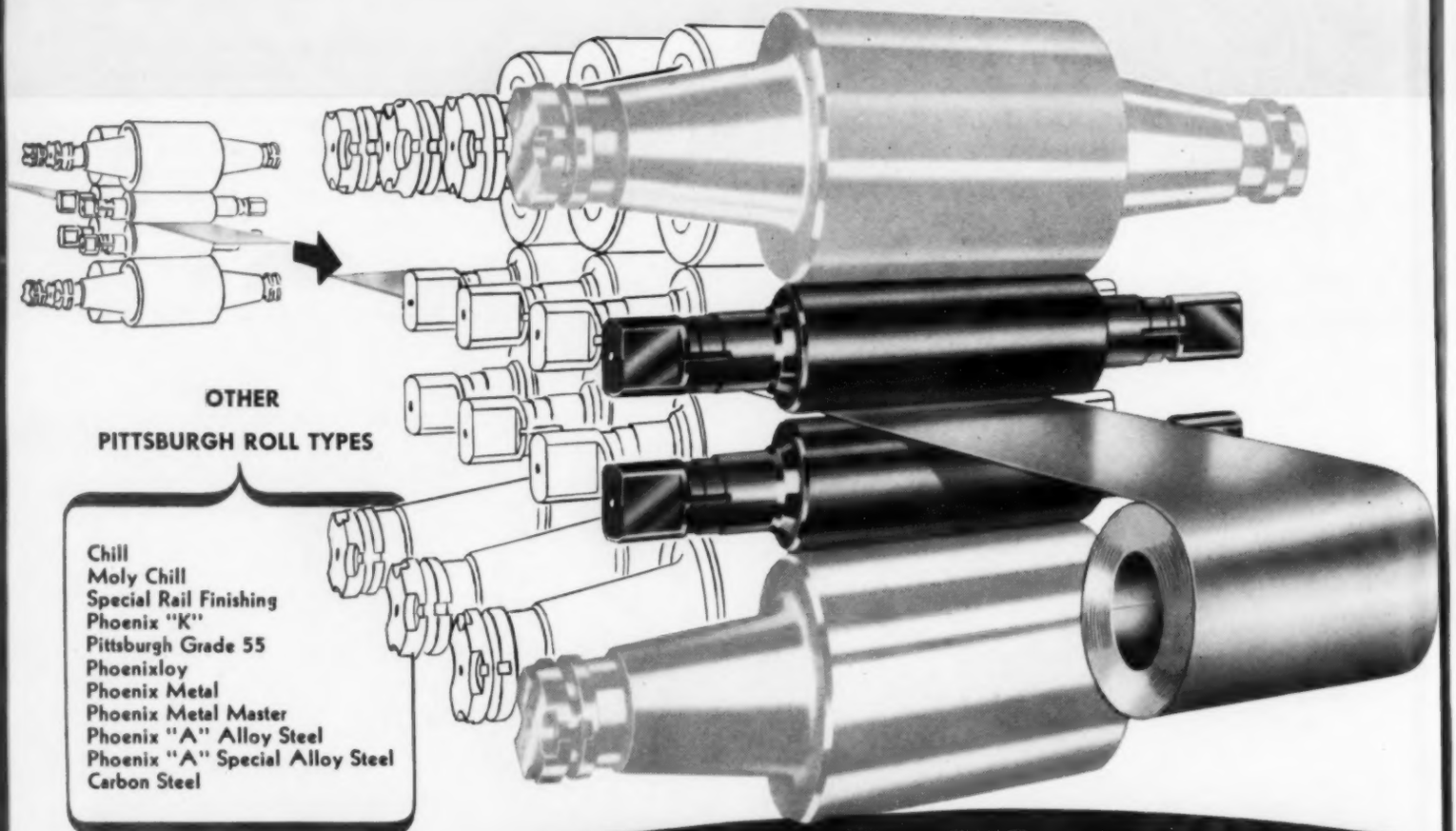
*PITTSBURGH GRADE ROLLS are color marked for specific uses in rolling . . .

*NICKEL ALLOY IRON

STRIP AND PLATE HOT MILL WORK ROLLS

FINISHING MILL STANDS (Chill or Grain Type)
- Pittsburgh Grade Special process
- Pittsburgh Grade 45
- Pittsburgh Grade 35
- Pittsburgh Grade 25

ROUGHING MILL STANDS (Grain Type)
- Pittsburgh Grade 35
- Pittsburgh Grade 25



OTHER PITTSBURGH ROLL TYPES

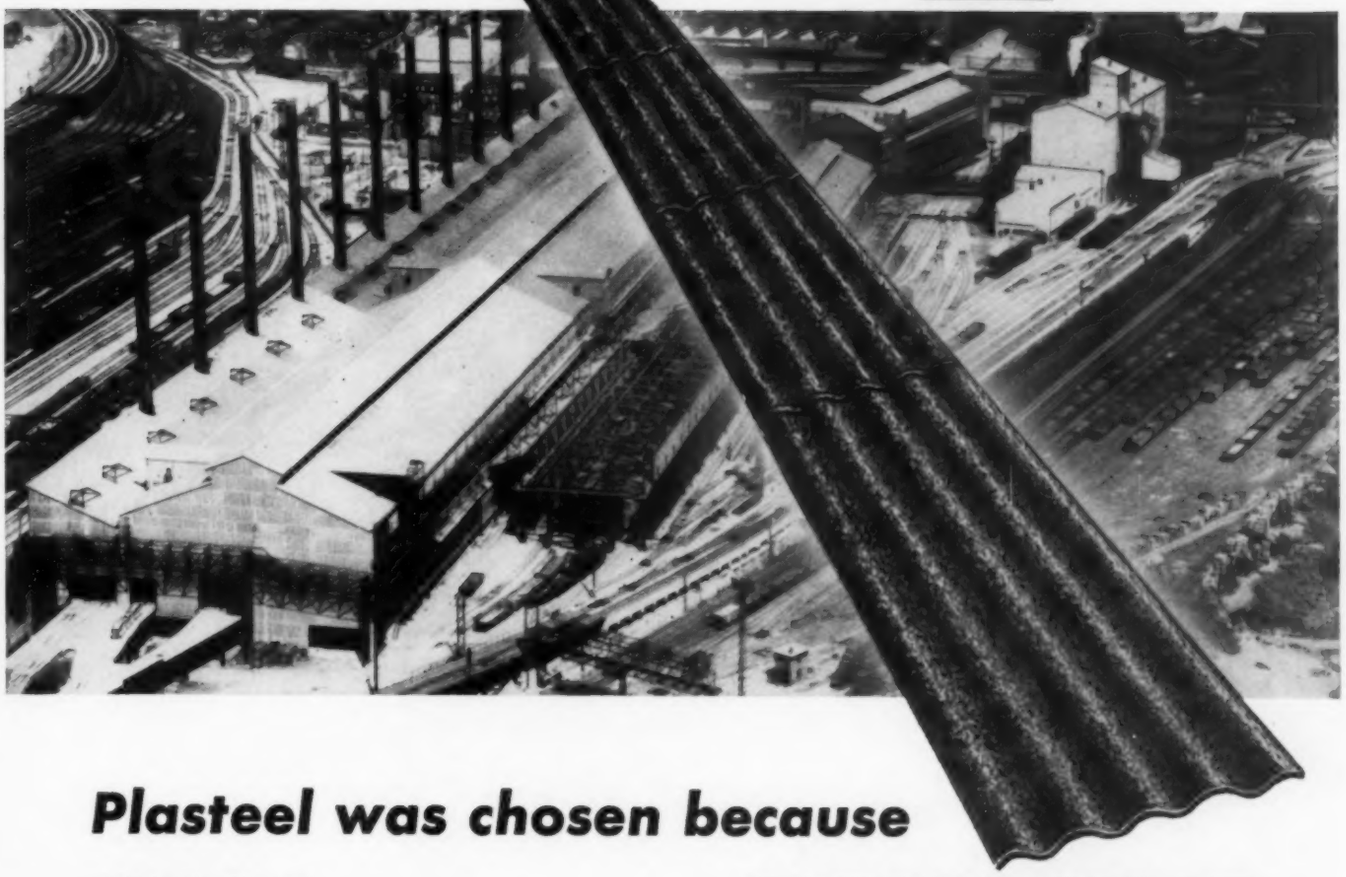
- Chill
- Moly Chill
- Special Rail Finishing
- Phoenix "K"
- Pittsburgh Grade 55
- Phoenixloy
- Phoenix Metal
- Phoenix Metal Master
- Phoenix "A" Alloy Steel
- Phoenix "A" Special Alloy Steel
- Carbon Steel

PITTSBURGH ROLLS

BLAW-KNOX COMPANY • PITTSBURGH ROLLS DEPARTMENT • PITTSBURGH, PA.

P.R.W.

40 miles of Plasteel sheets used on this J&L job



Plasteel was chosen because

MICA makes the DIFFERENCE

40 miles of *Plasteel* sheets—33" wide is a lot of roofing and siding. That, to the plant engineer, is 635,000 square feet of maintenance-free building protection. Only *Plasteel* gives you the advantages of Mica . . . and Mica makes a big difference! The Mica topping reflects the sun's rays and prevents the drying out of the volatile oils in *Plasteel's* asphalt-plastic coating. Mica prevents deterioration and practically eliminates maintenance costs. It provides a tough wearing surface, and gives *Plasteel* a pleasing finish. That's why more industrial building projects specify *Plasteel* today.

If you are planning new buildings, mail PLASTEEL Coupon today.*

PLASTEEL PRODUCTS CORPORATION

WASHINGTON, PENNSYLVANIA

ISE-11-53

* *Tested and classified by the Underwriters' Laboratories and Associated Mutual Laboratories.*

PLASTEEL PRODUCTS CORPORATION
WASHINGTON, PENNSYLVANIA

We are interested in *Plasteel* Roofing and Siding. Please send details checked below:

☐ Engineer's Handbook

☐ Sample of *Plasteel*

Company Name.....

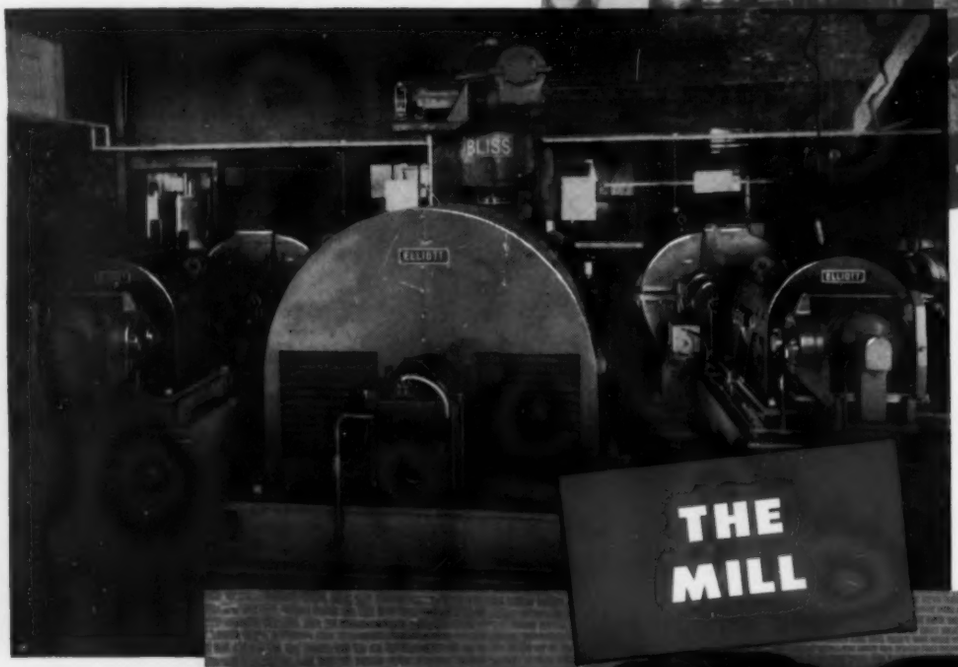
Attention of..... Title

Street or Box No.....

City..... State.....

MAIL THIS COUPON TODAY!

ELLIOTT Motors



THE MILL

◀ The main mill drive reversing motor—an Elliott 800-hp, 175/350-rpm, 600-v. At right and left, two Elliott 250-hp, 400/1200-rpm, 250-v reversing mill type reel motors.

The main motor-generator set—one 750-kw, 600-v, d-c mill generator, two 200-kw, 250-v, d-c reel generators, one 1500-hp, 4100-v synchronous motor, and one 30-kw, d-c exciter. All Elliott. ▼

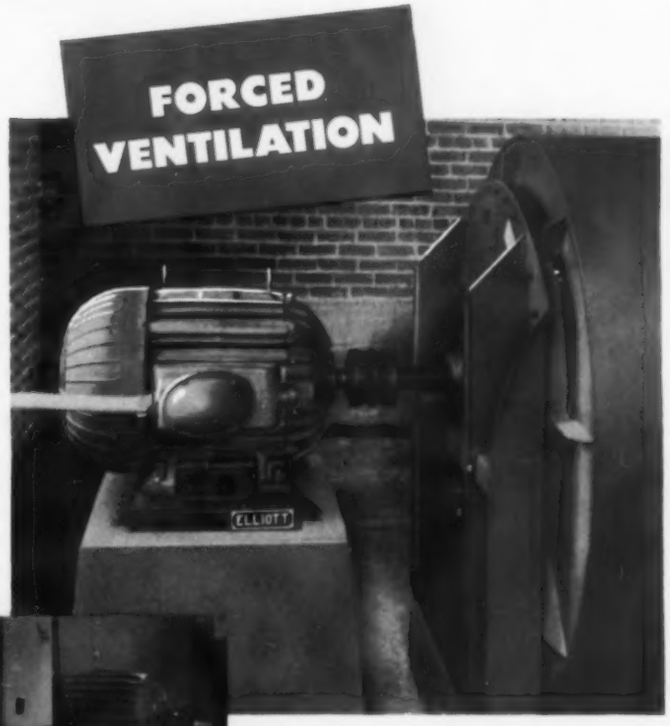
Elliott FABRI-STEEL MOTORS AND GENERATORS Q3-5

and Generators

power the new cold mill and slitter line for the Athenia Division, National Standard Co.

• The new Bliss 10 in. and 24 in. by 20 in. Four-High Reversing Cold Reduction Mill, with the Bliss 16 in. by 18 in. Slitter, adds new high capacity as well as quality product for the National Standard Company's Athenia Steel Division.

All electric motor drives, generators, and control for both the mill and the slitter line were furnished by Elliott Company. Generators, motors, and control have been carefully coordinated to give the close speed regulation necessary for the production of high quality strip.



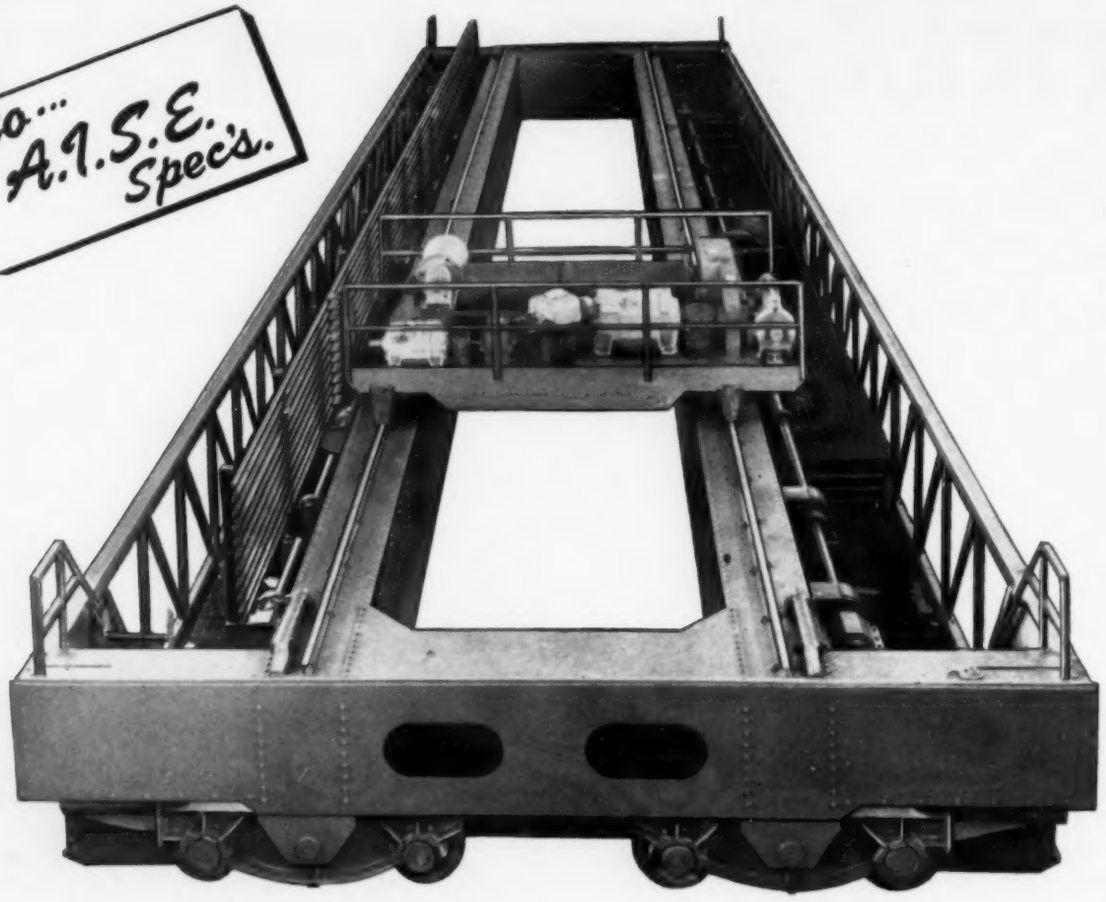
▲ The Elliott C-W "Sealedpower" 40-hp totally-enclosed fan-cooled motor that drives the fan supplying ventilation for the mill and reel motors.

◀ The drive for the Bliss Slitter is a Crocker-Wheeler 75-hp drip-proof induction motor. In the right background, an Elliott C-W 15-hp threader motor.

ELLIOTT Company

CROCKER-WHEELER DIVISION • RIDGWAY DIVISION

to... A.I.S.E. Spec's.



STEEL MILL CRANES . . .

by "Shaw-Box"

When you are ready to buy new mill cranes — built to your own or to A.I.S.E. Standard Specifications No. 6 — be sure to ask "Shaw-Box" about its mill cranes. In "Shaw-Box" Cranes you get cranes built exactly to specifications — plus all the advantages of "Shaw-Box" engineering, manufacturing methods, fine workmanship, and the maintenance conveniences which have built an enviable reputation for "Shaw-Box" equipment.

This 25-Ton "Shaw-Box" Crane, 100'-0" span — built to A.I.S.E. Standard No. 6 Specifications — is typical of "Shaw-Box" construction. If your cranes are to be built to these specifications, you will get maximum value for your crane dollars from "Shaw-Box" as "Shaw-Box" has the designs and has already built cranes from 15 to 100-tons capacity to A.I.S.E. Standard No. 6 Specifications.

Send All Your Inquiries for Cranes and Soaking Pit Carriages to "Shaw-Box".

MANNING MAXWELL & MOORE INC. MM TRADE MARK

"Shaw-Box" CRANES

MANNING, MAXWELL & MOORE, INC.

Muskegon, Michigan

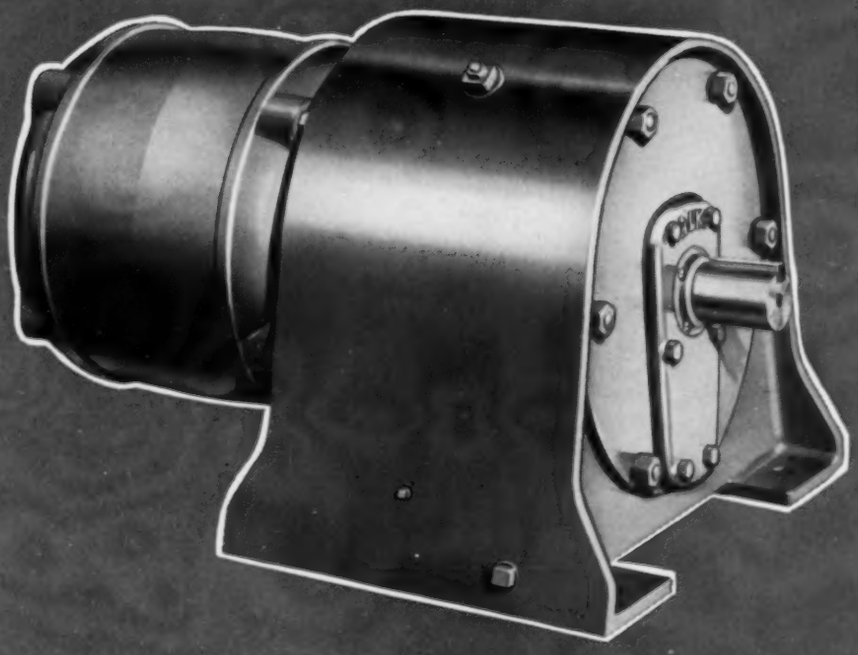
Builders of "Shaw-Box" Cranes, 'Budgit' and 'Load-Lifter' Hoists and other lifting specialties. Makers of 'Ashcroft' Gauges, 'Hancock' Valves, 'Consolidated' Safety and Relief Valves, 'American' Industrial Instruments and Aircraft Products.

Announcing the *–Newly Designed–* Integral

ALL-STEEL FALK Motoreducer

(Gearmotor Type–Supplementing Falk All-Motor Line)

. . . with completely standard round-frame, D-flange motor



Check and Compare these features...

Meet a faithful old friend in a new, modern dress! The famous, time-proved Integral Type *all-steel* Falk Motoreducer (Supplementing Falk All-Motor Line) has been redesigned into a compact, streamlined unit providing the utmost in space economy—but retaining all the application versatility, long-life performance, easy-maintenance features and superior structural qualities that have made Falk Motoreducers the recognized standard throughout industry.

In this new Integral unit—rated in accordance with AGMA standards—a *completely standard* round-frame, D flange NEMA motor is mounted directly on the all-steel Motoreducer housing. The motor remains a separate piece of equipment, readily replaceable with any other type or make. Output speed (ratio) can be changed within unit's torque capacity without modifying motor. Size and arrangement of the standard housing permit wide ratio range—from 3.36:1 to 542:1.

In order to meet the greatest number of industrial application needs, the newly designed Integral Motoreducers are available in horizontal and vertical models, both in concentric and right-angle types; double, triple and quadruple reduction; horsepower range, 1 to 40 HP. Prompt stock shipment in standard ratios is offered.

Whatever your reduction requirements, you get greatest dollar-for-dollar value in the long run by standardizing on Falk products. Write for Bulletin 3104.

Every FALK Motoreducer has these "In-built" Factors—

Precision Gearing. Heat treated alloy steel, precision cut and shaved helical gearing throughout . . . quiet-operating crown shaved pinions . . . taper bored gears for easy ratio changes.

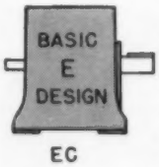
All-steel Housings. Unbreakable, strong, rigid. Generous overhung load capacities provided by wide bearing spans, large shafts and bearings.

Streamlined inside and outside. Smooth, clean surfaces; machine welded construction conforms to NEMA motor frames.

Positive Lubrication. Large sump capacity . . . oil-tight construction assures clean lubricant . . . direct dip of revolving elements provides positive lubrication at all speeds.

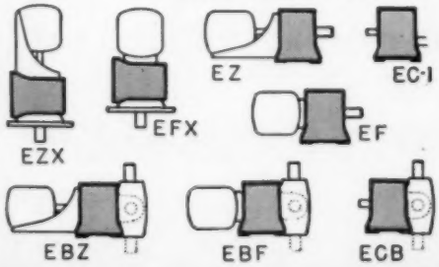
Wide Speed Range. Selective ratio combinations provide output speeds from 1.5 rpm to 1430 rpm with stock gears.

Sealed Housings. Dual closures and one-way vents keep oil *in*, dust and moisture *out*. Units are splash-proof, leakproof, dustproof.



EC

The basic E design permits maximum use of standardized parts . . . closer control over materials, processing, inspection and assembly . . . resulting in faster delivery from interchangeable stocked assemblies.



FALK ...a good name in industry

THE FALK CORPORATION · 3001 W. Canal St. · Milwaukee 8, Wis.

WRITE FOR BULLETIN 3104

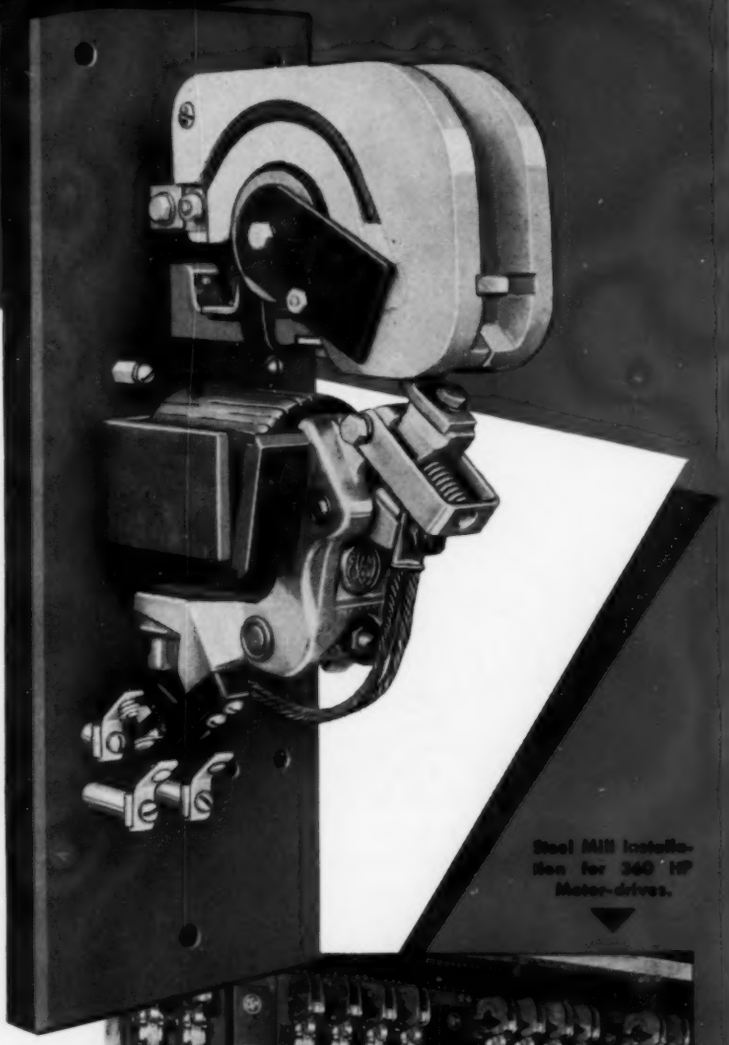
Designed for Low Up-Keep

PROVEN IN HUNDREDS OF PLANTS

EC&M

LINE-ARC

CONTACTORS



Steel Mill installation for 360 HP Motor-drives.

You can meet production demands better with EC&M Magnetic Controllers, because they are easy to get along with, easy to service on a preventive maintenance basis and low on upkeep.

The LINE-ARC principle keeps costs down and saves maintenance-time. Don't overlook these important advantages when buying mill and crane control:

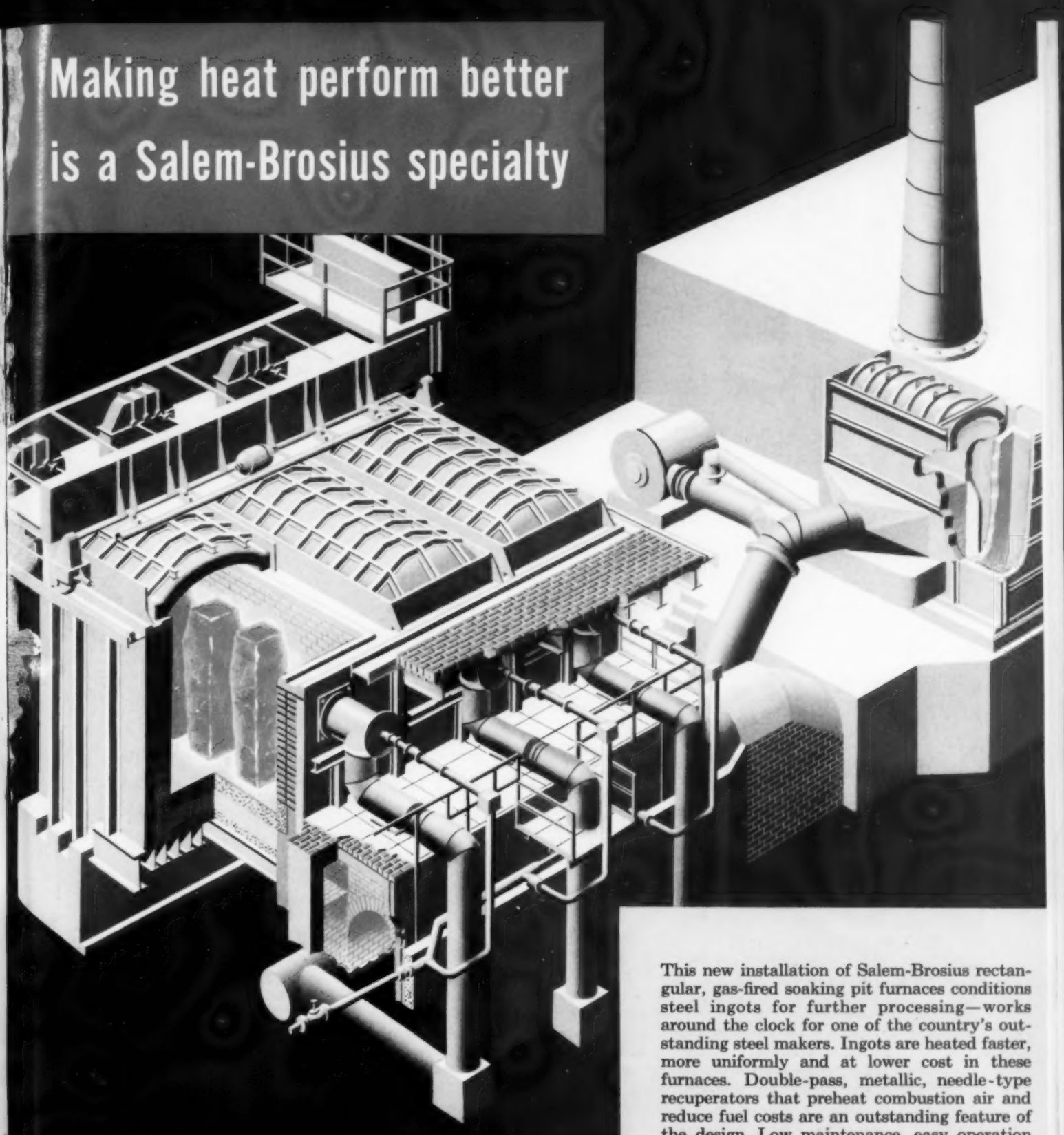
1. Cool contact operation—longer contact life.
2. Lengthened Arc Shield life — the LINE-ARC principle centers the arc, so that destructive burning is eliminated.
3. Safer electrical interlocks—double-break, coin-silver contacts. The moving normally-open and normally-closed contacts are insulated from each other.
4. Foremost accessibility for inspection and part-replacement—delays prevented because maintenance is encouraged.

It pays to specify EC&M Control

THE ELECTRIC CONTROLLER & MFG. CO.

2698 East 79th Street Cleveland 4, Ohio

Making heat perform better is a Salem-Brosius specialty



This new installation of Salem-Brosius rectangular, gas-fired soaking pit furnaces conditions steel ingots for further processing—works around the clock for one of the country's outstanding steel makers. Ingots are heated faster, more uniformly and at lower cost in these furnaces. Double-pass, metallic, needle-type recuperators that preheat combustion air and reduce fuel costs are an outstanding feature of the design. Low maintenance, easy operation and long service life are standard with Salem-Brosius designed furnaces.

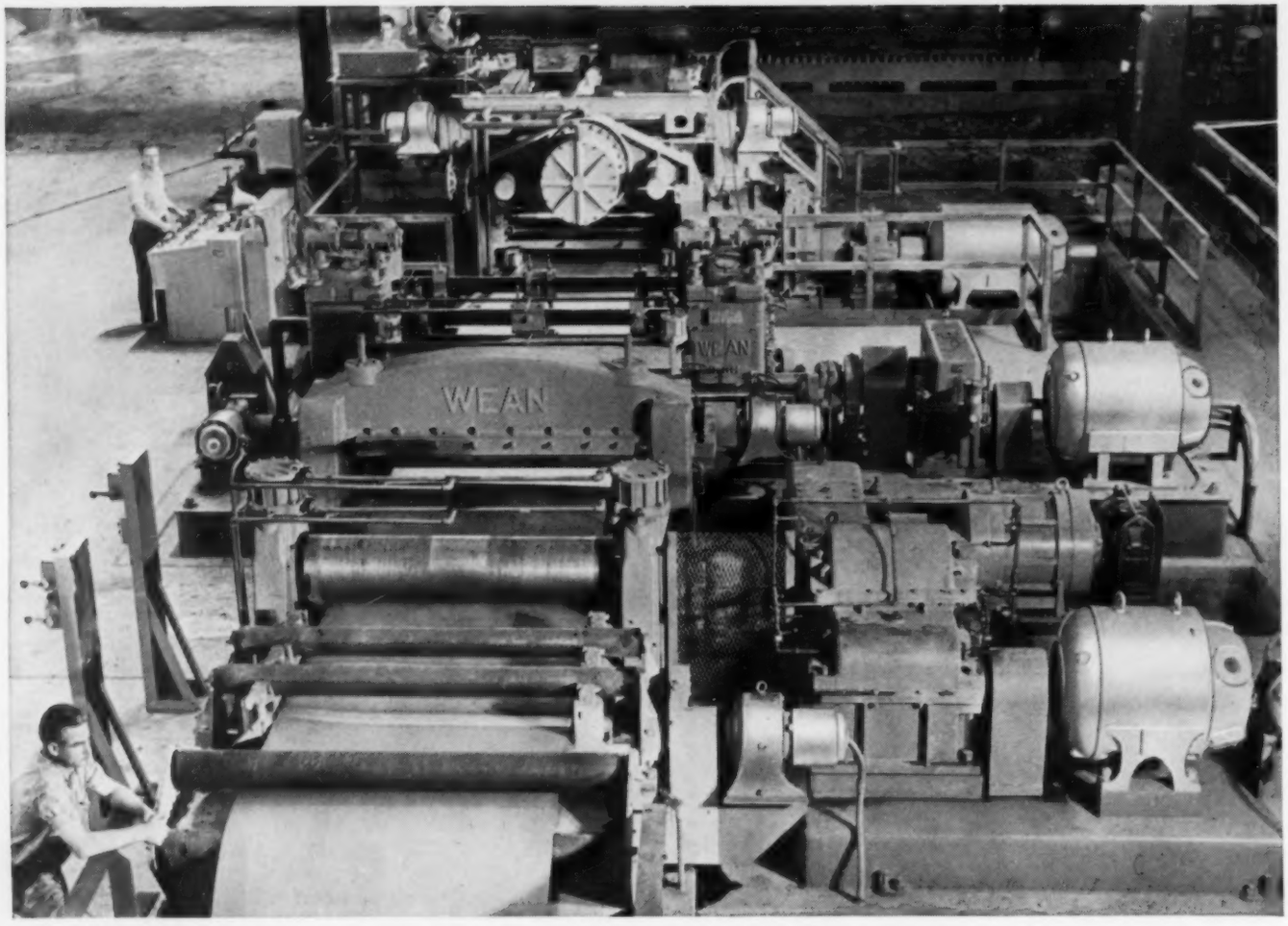
Salem-Brosius engineers are specialists in performance and control of heat in manufacturing, offering furnaces custom-built to your requirements. Salem-Brosius furnaces assure you maximum high-quality output at minimum initial, operating, and service costs.

We would like to tell you more about the efficiency of these new units, and also about the well-known Salem-Brosius circular soaking pits.

If your modernization or expansion plans call for heating or heat treating furnaces of any kind, furnace charging or forging manipulation equipment, valves, or hot materials handling machinery; write, wire, or phone Salem-Brosius!

Salem-Brosius, Inc.

Sales and Executive Offices:
248 Fourth Avenue, Pittsburgh 22, Pa.



ANOTHER HIGH-PRODUCTION PROCESSING LINE WITH RELIANCE HEAVY-DUTY MOTORS

This continuous pickling line at Pittsburgh Steel's new Allenport mill is one of the most modern in the industry. Pittsburgh Steel and its equipment suppliers chose Reliance Motors, both a-c. and d-c., totaling some 2500 hp. These drives employ Reliance motor-generator sets, and Reliance rotating (VSA) regulators for voltage (speed) control of the line. Current-limit accelerating and decelerating controls on the entry and delivery sections keep the center or processing section in continuous operation at the maximum speed consistent with top-quality production.

Choice of Reliance at Pittsburgh Steel follows logically from the outstanding performance and dependability record of Reliance drives on 80% of all pickling lines in the industry.

In your application, too! The diversity of processing lines in the iron and steel and nonferrous metals industries driven by Reliance Motors explains why long-time users have come to regard them as unsurpassed in dependability. Installations include the fastest continuous pipe mill in the world . . . the biggest seamless tube mill ever built . . . one of the most modern brass mills in operation today . . . the world's widest aluminum strip mill.

To get the right combination of dependable equipment . . . plus skillful application . . . in *your* application, call on Reliance. A call to your nearby Reliance Sales Office . . . or a letter to us direct . . . will place at your disposal nearly 50 years of specialized experience in the application of electric drives. A-1471

RELIANCE Precision Built MOTORS

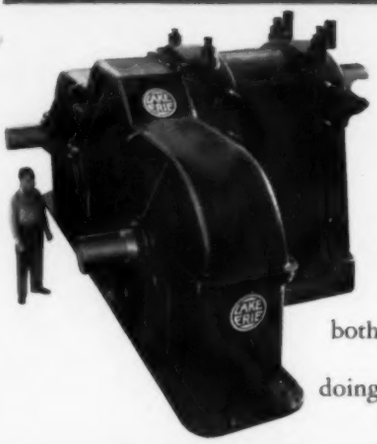
RELIANCE ELECTRIC AND ENGINEERING CO.

1084 Ivanhoe Road, Cleveland 10, Ohio • Sales Representatives in Principal Cities

RELIANCE V•S SYSTEM

MOTORS • GEARMOTORS • ADJUSTABLE-SPEED DRIVES • MOTOR-GENERATOR SETS • ELECTRONIC AND MAGNETIC CONTROLS AND REGULATORS

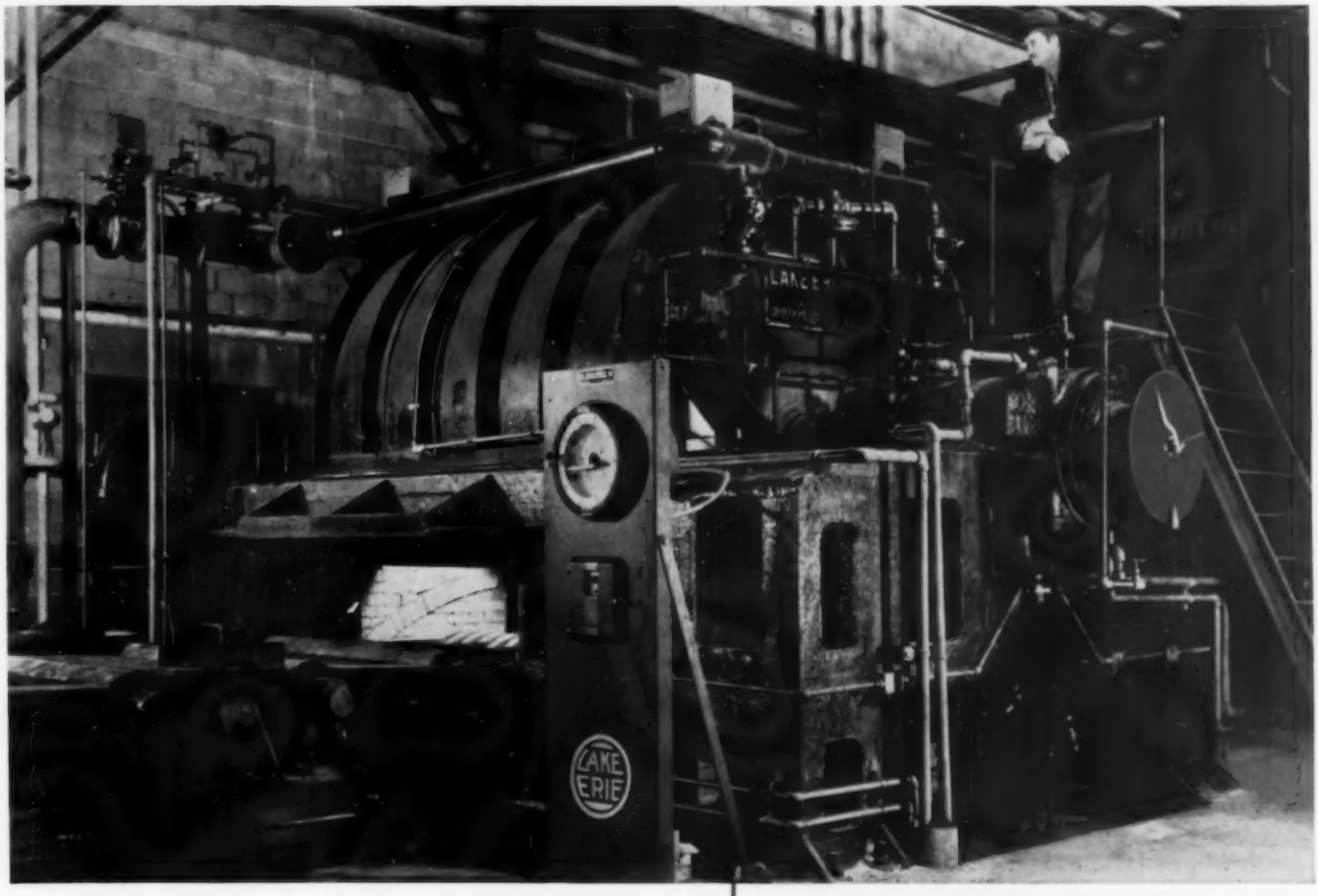
Want a pleasant surprise?



ASK US TO QUOTE ON YOUR NEXT REQUIREMENT FOR ROLLING MILL AUXILIARY EQUIPMENT

You'll find...as have industrial firms throughout the world...that Lake Erie offers the utmost in quality, price and delivery for heavy industrial machinery.

Mills in the Buffalo area (and occasionally elsewhere) have done business with us for years. The fine acceptance of our auxiliary equipment and services by both ferrous and non-ferrous industries has prompted us to expand our sales of this equipment to all areas. Ask us to quote and judge for yourself the advantage of doing business with one of the most completely equipped plants and experienced staffs in the heavy machinery field.



THE FOLLOWING WILL SERVE AS A BUYING GUIDE WHEN YOU ARE CONSIDERING REPLACEMENTS OR ADDITIONS

INDIVIDUAL UNITS

Mill tables and conveyors • Coilers and uncoilers
Shears, up-cut and down-cut • Pay off and take up reels • Stretcher levelers
Wet and dry scrubbers • Scrap ballers and balers • Turn tables
Dancer roll units • Belt wrappers • Slitters and side trimmers
Roller levelers • Pilers and unpilers • Coil ramps and coil boxes
Oiling machines • Dryers • Upenders and downenders
Tension bridles • Shear gauges • Peelers and processors

COMPLETE LINES

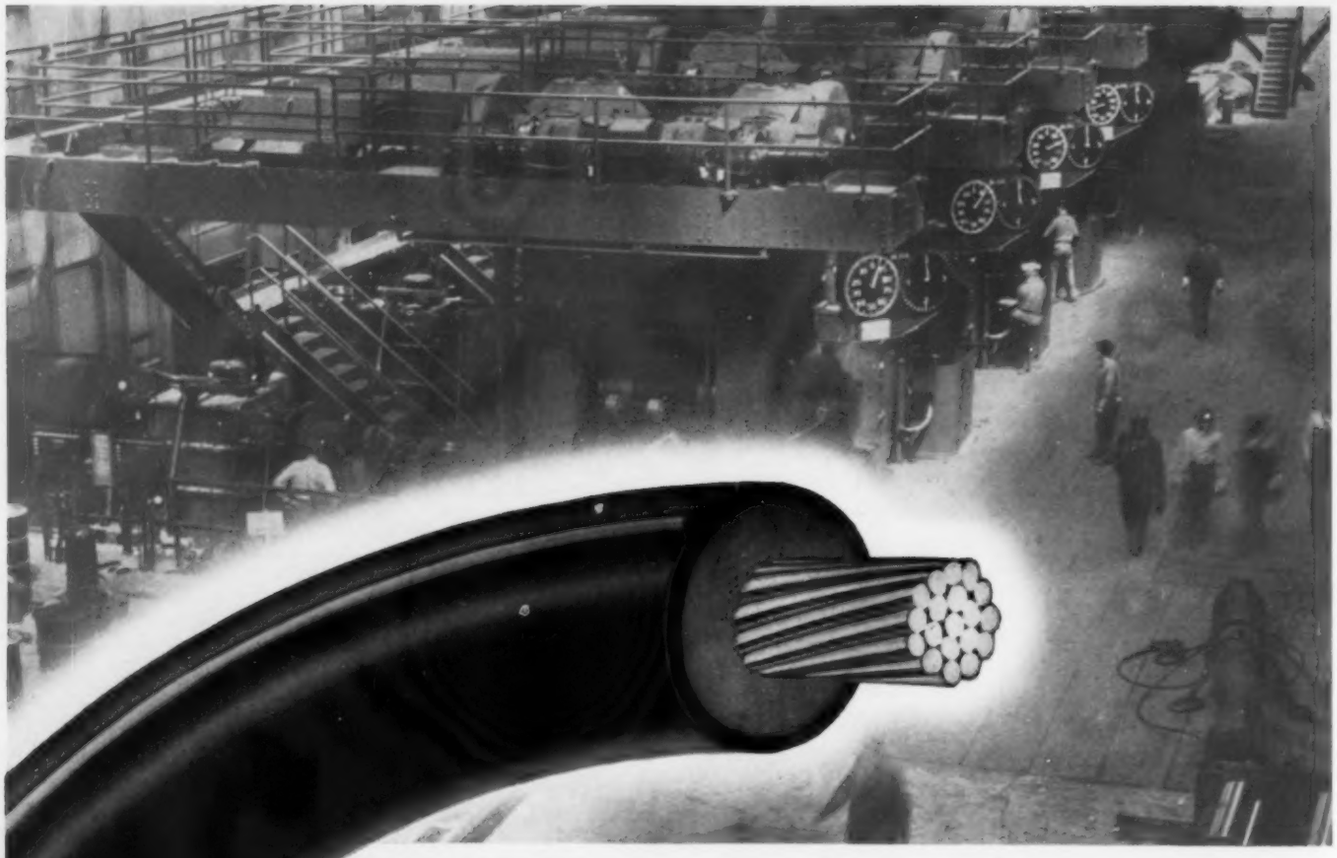
Coil build up lines • Sheet pickle lines • Sheet and strip shearing lines
Cleaning lines • Strip pickle lines • Resquare lines
Slitting lines • Annealing lines

PLUS REBUILD SERVICES

LAKE ERIE®

LAKE ERIE ENGINEERING CORP.
ENGINEERING CORP.
BUFFALO, N.Y. U.S.A.

LAKE ERIE ENGINEERING CORP.
570 Woodward Avenue, Buffalo 17, N. Y.
HYDRAULIC PRESSES • DIE CASTING MACHINES
ROLLING MILL AUXILIARY EQUIPMENT



CUT OUTAGE TIME ALL ALONG THE LINE

with OKOLITE-OKOPRENE electrical cables

Steel mill conditions are rough on electrical cables. Heat, flame, moisture, dirt, mechanical damage, corrosive fumes—the life of an electrical cable is a continual fight against such elements. Electrical men in the steel industry reduce outages due to such conditions with Okolite-Okoprene cables.

Okolite-Okoprene is particularly suitable for use in steel mills because of the exceptional properties of its electrical insulation and protective sheath.

Okolite insulation, itself resistant to heat and moisture, is highly reliable under the continuous heavy usage characteristic of steel mills. Okolite has proved itself by a long record of trouble-free operation under severe service conditions.

Okoprene protective sheath is compounded from an exclusive Okonite formulation, the basis of which is neoprene. It contains no rubber. When exposed to most acids, alkalies, chemicals, oils and moisture, it will outperform any other common type of cable covering such as lead or braid.

Okonite's famous strip process, for applying insulation and sheath simultaneously, adds still greater endurance to the cable. Conductors are perfectly centered, and both sheath and insulation are uniformly vulcanized to give higher mechanical and electrical properties of lasting quality.

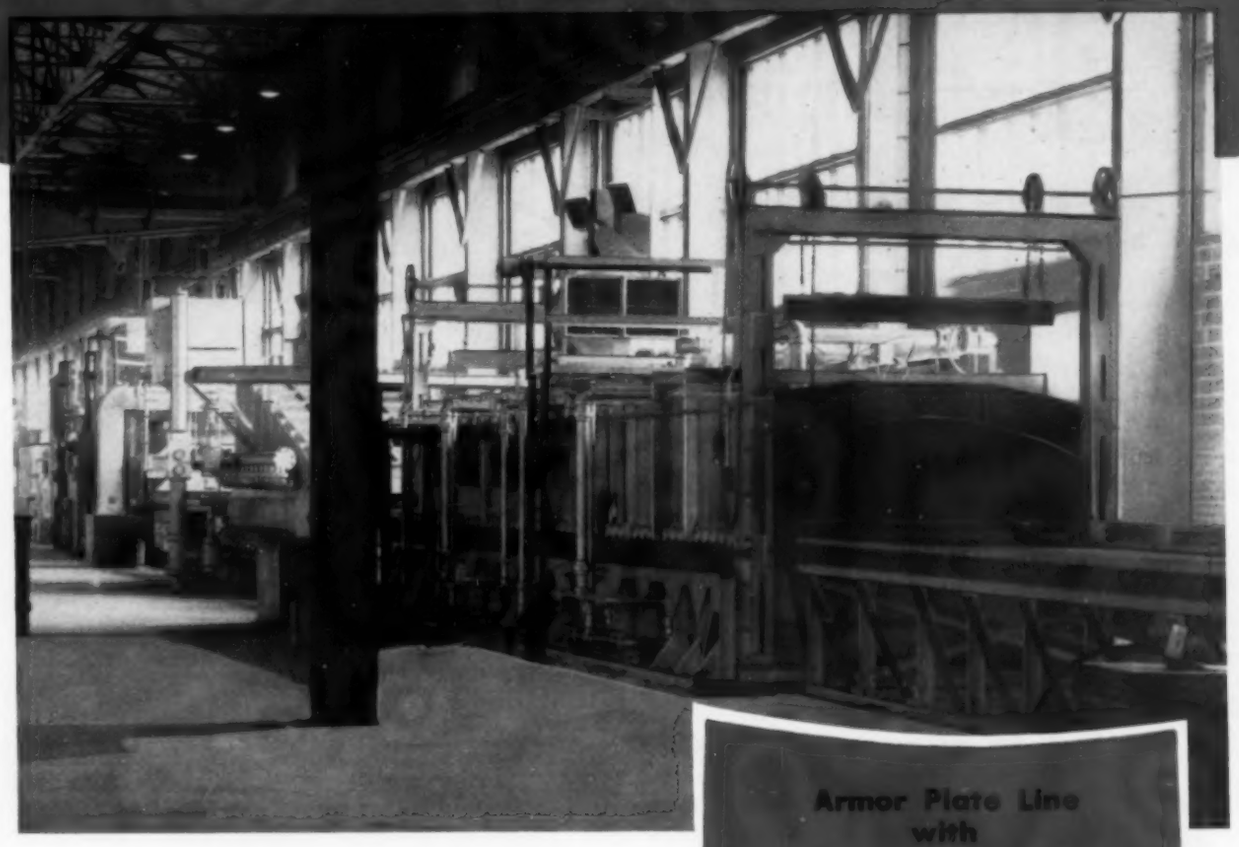
Bulletin IS-1053 gives convincing facts on the stability and performance of Okolite-Okoprene. Write for it today to The Okonite Company, Passaic, N. J.

The best cable is your best policy

OKONITE SINCE 1878 *insulated wires and cables*

9804

DREVER CONTINUOUS ARMOR PLATE HEAT TREATING LINES



Armor Plate Line with Pressure Quench

Integrated High Capacity Heat Treating Lines featuring the Pressure Quench...produces ***FLAT*** *high quality Plate*

Continuous, oil or gas fired Roller Hearth Furnaces for hardening and tempering both face hardened and homogeneous armor plate. Also Carburizing Furnaces and Car Type Furnaces for heat treating. Whatever your specific problem, consult DREVER.

DREVER CO.
730 E. VENANGO STREET
PHILADELPHIA 34, PENNA.
W. PENNA., W. N. Y. AND OHIO — H. C. BOSTWICK, 19400 S. MORELAND BLVD., CLEVELAND 22, OHIO

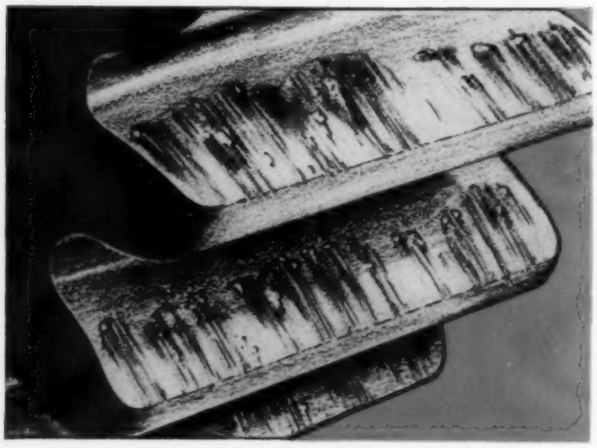
switch to

GULF E.P. LUBRICANTS

and get the benefit

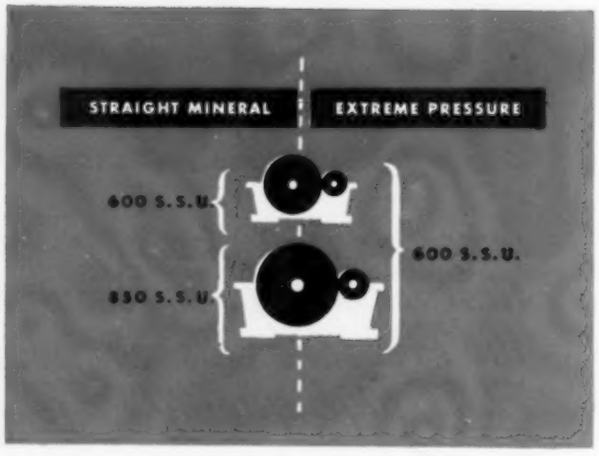
1 **More effective protection against tooth scoring and welding**

Gulf E. P. Lubricants have proven ability to protect gear teeth against damage by scoring and welding. They are specially compounded to provide extra film strength and to prevent metal-to-metal contact under most conditions of overload and shock load. That's why you can usually avoid tooth damage like that shown at the right when you use Gulf E. P. Lubricants. And that's why they provide an extra margin of protection when production demands approach or exceed the rated capacity of the equipment.



2 **Fewer lubricant grades needed— lubricant storage and handling simplified**

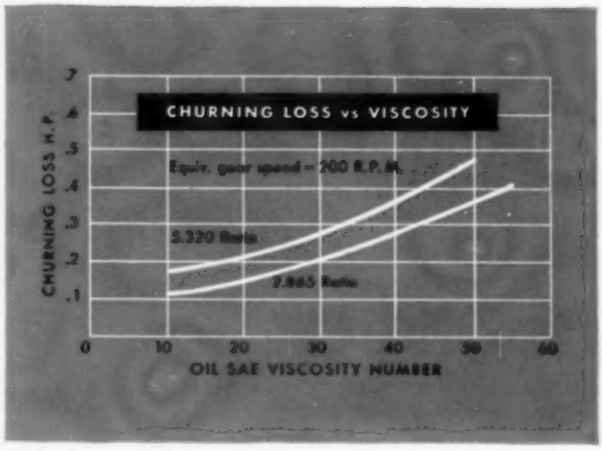
Because Gulf E. P. Lubricants have superior film strength, it is often feasible to use a lower viscosity grade than would be possible with a straight mineral oil. This is a practical advantage for plants operating several different types of gear drives. If, as pictured at the right, two straight mineral oils of different viscosity are specified, one grade of Gulf E. P. Lubricant may well do the job of both. Thus lubricant storage and handling is simplified, and there is less chance for confusion in the oil house.



Gulf E. P. Lubricants are available in the proper viscosity for every gear requirement, ranging from 55 to 1000 SUV at 210 deg. F. For specific recommendations for your equipment, call in a Gulf Sales Engineer. Write, wire, or phone your nearest Gulf office, or send the coupon.

for enclosed gear drives

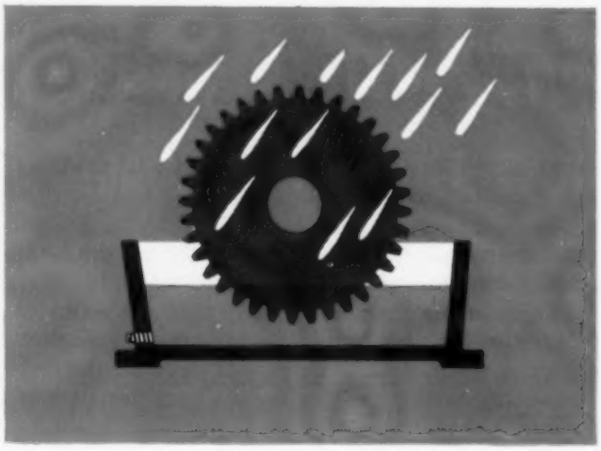
of these practical advantages:



3 **Reduced power loss caused by churning in splash-lubricated units — lower power costs**

There is another advantage in using a lower viscosity oil in splash-lubricated units where power loss due to churning is appreciable. Since this loss is almost directly related to oil viscosity, the use of lighter Gulf E. P. Lubricants often means reduced heat generation and lower power costs.

The chart at the left shows the effect of viscosity on the churning loss in horsepower of a typical gear unit.



4 **Excellent protection against rust**

The ability to protect polished gear teeth and antifriction bearings against rust is an important property of a gear lubricant, and is essential in a lubricant for units which are occasionally idle.

Gulf E. P. Lubricants have highly effective rust preventive properties—insure against excessive wear and enlarged tolerances which might result from the presence of abrasive rust particles.

GULF INDUSTRIAL LUBRICATION

GULF OIL CORPORATION • GULF REFINING COMPANY
1822 Gulf Building, Pittsburgh 30, Pa.

I&SE

Gentlemen:

I would like further information on Gulf E.P. Lubricants:

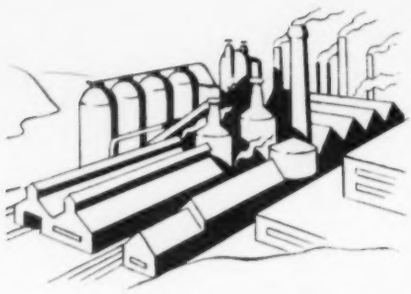
- ☐ Please have a Gulf Sales Engineer call.
- ☐ Please send me a copy of your pamphlet "Gulf E.P. Lubricants for Reduction Gear Drives."
- ☐ Please arrange to show a group in our plant the new Gulf Color Slide Film, "Gears and Their Lubrication," Part I.

Name_____

Company_____

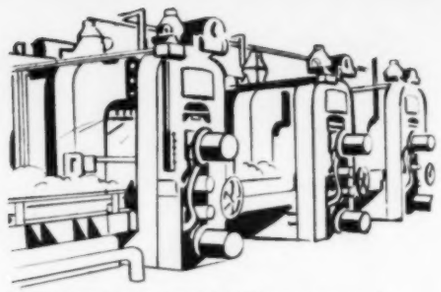
Title_____

Address_____

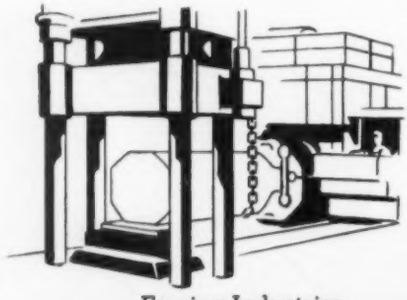


Steel Producing Plants

WHEN A *REGULAR LUBRICANT* ISN'T GOOD ENOUGH . . .



Hot Strip, Cold Reduction and Temper Pass Mills



Forging Industries

SPECIFY LEADOLENE* *Klingfast*

CHECK THESE 9 IMPORTANT FACTS:

1. **EXTREME PRESSURE pH-ilm STRENGTH** of 50,000 lbs. per square inch minimum by "Timken" testing machine.
2. **ADHESIVENESS** in which affinity for steel and other metals develops maximum adhesion and prevents drippage or creeping. Retains a flexible coating in nature.
3. **WATER REPELLENCE** which retards washing off, creates a lubricating pH-ilm under moisture or water conditions.
4. **CORROSION PREVENTION** is an excellent protective coating in that it will not etch or corrode metals. Is never acidic.
5. **COMPOUNDED STABILITY**—Will not bleed or change physical condition within range of higher than usual temperatures for this type of lubricant.
6. **LOW TEMPERATURE FACTORS**—While having a solidifying action by decreased temperature as low as —40 F., it does not harden, crack or decrease in adhesion. The flexible coating withstands distortion of the application.
7. **ABRASIVE RESISTANCE**—Extremely high for a lubricant. Does not wipe off nor will be removed in handling by workmen's hands or gloves. Is extremely repellent to adhesion of scale, metallics and other forms of dusts or contamination.
8. Klingfast has remarkable corrosive resistance to salt or sea water, acidic vapors and solutions.
9. Klingfast can be removed by ordinary solvents such as kerosene, gasolene, naphtha, carbontetrachloride and similar substances but is highly impervious to lubricating oils and greases.

The "I.P." LUBRICANT*

On the really tough jobs in the steel industry, the answer to vastly reduced lubricating costs and extended equipment life is *Leadolene Klingfast.* Capable of withstanding pressures up to 50,000 p.s.i., this lead-base lubricant with its "indestructible pH-ilm" has proved itself repeatedly on the most difficult applications.

For efficient lubrication in the presence of water . . . for extreme adhesiveness to steel under high heat conditions . . . for unexcelled abrasion and corrosion-resistance . . . for actual cash savings up to 400 per cent—investigate the performance characteristics of *Leadolene Klingfast.*

*I. P. . . . ("Indestructible pH-ilm" lubricant)

Write for 24-page descriptive booklet

THE BROOKS OIL CO.

Since 1876

Executive Offices and Plant ..... Cleveland, Ohio
Executive Sales Offices ..... Pittsburgh, Pa.
Canadian Offices and Plant ..... Hamilton, Ontario
Cuban Office ..... Santiago de Cuba

Warehouses in Principal Cities

CODDLE THE COMMUTATOR

WITH NATIONAL BRUSHES FOR MAIN-DRIVE, MILL-TYPE and GENERAL-PURPOSE MOTORS

TRADE-MARK

PROPERLY MAINTAINED, commutators are among the least of your operating worries. Neglected, they can cause reduced efficiency, shortened brush life, costly down-time — even, in extreme cases, shutdown of production.

AT THE COMMUTATOR, more than at any other motor component, *minutes,* regularly spent on care, add *hours* to the period between overhauls. Coddle the commutator, and your motors and generators will return your investment many times over.

AN IMPORTANT PART of commutator care is the proper selection of brushes, brushes that give peak commutation . . . low friction . . . proper surface film — "NATIONAL" BRUSHES!

SATISFY THESE CONDITIONS and your brushes will *last* longer, too — as "National" brushes are known to do!

How good is really good brush performance?
– Try "National" brushes and see!

NATIONAL **STANDARDIZED BRUSHES**

BETTER– PRODUCT–PACKAGE–PRICE– FASTER

The term "National", the Three Pyramids device, and the Silver Colored Cable Strand are registered trade-marks of Union Carbide and Carbon Corporation

NATIONAL CARBON COMPANY
A Division of Union Carbide and Carbon Corporation
30 East 42nd Street, New York 17, N. Y.

District Sales Offices:
Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco

In Canada: National Carbon Limited
Montreal, Toronto, Winnipeg

When you install

NORTHERN OVERHEAD ELECTRIC TRAVELING CRANES

you will have fast, safe, dependable materials handling with an extra margin of safety for overloading under peak or emergency operation—the best mechanical and electrical accessory equipment and controls that can be obtained—precise manipulation, minimum maintenance, and maximum efficiency—integrated engineering design and construction of the highest quality. Ask for Catalogs SE-108 and HL-115-R.

NORTHERN HI-LIFT HOISTS

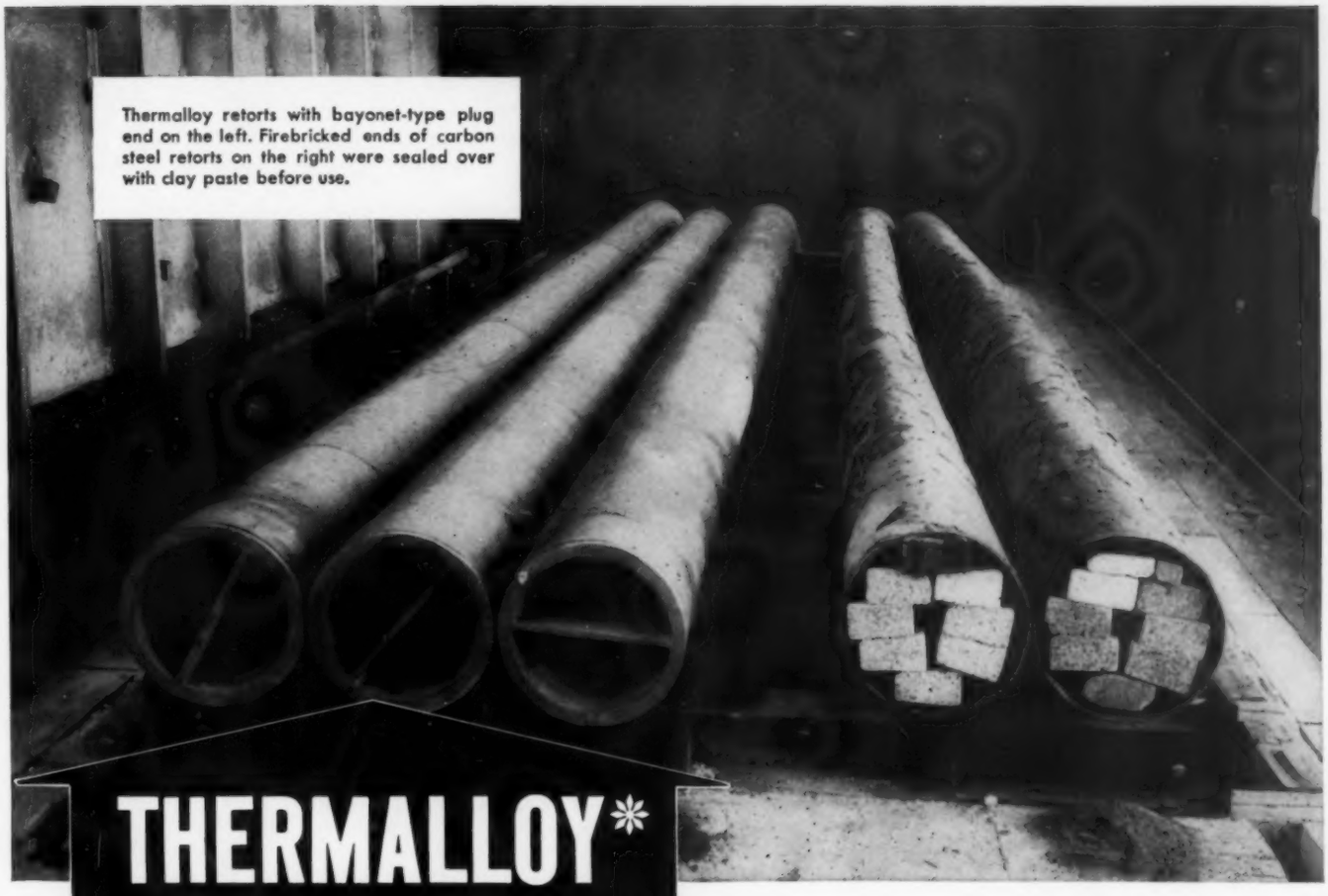
you will get an extra quality, high hook lift, heavy duty type hoist—the only hoist of this type available. It ranges in capacities from one to 15 tons (100 tons in stationary types) and is adapted for I-beam, monorail or tramrail systems—for floor or cab control—single or variable speeds. Other models also include: double hook, base mounted, and lug suspension hoists. Ask for Bulletin H-113.

NORTHERN TRAVELATORS

you will save time, maintain production, increase safety with a low cost, simple device which converts your hand powered cranes to motorized control. It can be easily installed by your own mechanics in a few hours without dismantling your present crane. Ask for Bulletin T-105.

NORTHERN ENGINEERING WORKS

210 CHENE ST., DETROIT 7, MICHIGAN



Thermalloy retorts with bayonet-type plug end on the left. Firebricked ends of carbon steel retorts on the right were sealed over with clay paste before use.

THERMALLOY*

outlasts carbon steel retorts . . . 28 to 1

In a plant of a large eastern tool and specialty steel manufacturer, long, pipe-like retorts are used to anneal and heat-treat high-speed carbon and alloy steel bar stock in hood-type furnace equipment. Temperatures range up to 1650°F. during the annealing or heat-treating cycle that may last 30 hours.

Under these conditions, this manufacturer found that wrought carbon steel retorts scaled excessively and also distorted and flattened during operation . . . limiting service life to about 500 cycle hours. For the same operation, centrifugally cast Thermalloy retorts showed no measurable scale loss and maintained uniform wall thickness and shape. When last reported, Thermalloy retorts had been operating over 14,000 cycle hours and were still in perfect condition.

As the wrought carbon steel retorts became distorted, the plugs necessary to seal the open ends would not fit. Firebrick and a clay paste were used to seal the ends against infiltration of furnace gases. This made uniform annealing or heat-treating practically impossible. However, Thermalloy retorts, with plug ends designed by Electro-Alloys, afforded practically gas-tight seals and much greater ease of handling.

Today, this manufacturer is replacing all of the wrought carbon steel retorts with high heat-resistant Thermalloy retorts. Perhaps the same operating economy may interest you in Thermalloy retorts, furnace parts, trays, racks, pots or muffles. For full information, call in an Electro-Alloys engineer or write Electro-Alloys Division, 4007 Taylor Street, Elyria, Ohio.

*Reg. U. S. Pat. Off.

AMERICAN Brake Shoe COMPANY

ELECTRO-ALLOYS DIVISION
ELYRIA, OHIO

Cleveland Cranes
FOR
STEEL MILL SERVICE
15 TON
CLEVELAND CRANE
2-7½ TON HOOKS
CLEVELAND CRANE
CLEVELAND CRANES
MODERN ALL-WELDED STEEL MILL CRANES
5031 EAST 289th ST.
WICKLIFFE, OHIO

Crops *and* Shorts

STEEL men and industry in general are becoming more optimistic over business prospects for the near future. They are overcoming what Dr. Leland I. Doan, president of Dow Chemical Co. calls "economic hypochondria."

C. M. White, president of Republic Steel Corp., told a meeting of security analysts that he "cannot see anything in the near future to scare us. We have been operating at 100 per cent so long that some get alarmed at 90 per cent prospects." He believes business will fluctuate, but expects no deep recession. Mr. White also stated that "without excess profit taxes, without overtime and with our added productive capacity, Republic should do as well in 1954 as in the current year."

And the current year might be termed very good, as indicated by current market trends and typified by Bethlehem Steel Co.'s nine-month report showing new records for production, shipments, payroll and earnings. Bethlehem's chairman, Eugene Grace expects good business throughout 1954.

Contributing to the new feeling is the belief that break-even points for steel producers are not as high as previously estimated. E. J. Hanly, president of Allegheny Ludlum Steel Corp., believes his company "ought to be able to earn a profit" even at operating rates as low as 65 per cent of capacity.

▲

WE always thought that no one knew what the age of discretion was because no one ever reached it, but the man next door says it's when you are too young to die and too old to have any fun.

And as we approach it, we find the best time for a cold shower is some other.

▲

THIS is an old definition but a lot of our readers probably never heard it: An engineer is a person who passes as an exacting expert on the basis of being able to turn out with prolific fortitude infinite strings of incomprehensible formulae calculated with micrometric precision from vague assumptions which are based on debatable figures taken from inconclusive experiments carried out with instruments of problematical accuracy by persons of doubtful reliability and questionable mentality for the avowed purpose of annoying and confounding a hopeless chimerical group of fanatics referred to, all too frequently, as engineers.

TOTAL shipments of steel mill products for the first eight months of 1953 set a new record for any similar period at 55,432,982 net tons. Almost 20 per cent of this went to the automotive industry.

▲

ONE of our bookish friends says it's easy to tell when a book is the kind that will improve your mind — you begin to yawn after reading a few pages.

▲

THE idea of a New England steel plant has again shown signs of life with the sale of stock of the New England Steel Development Corp., set up two years ago by business men of that area. Application was made for a new certificate of necessity. The Office of Defense Mobilization "conditionally approved" a quick tax write-off allowance on $20,502,000 of $26,400,000 worth of steel production and finishing facilities to be constructed by New England Steel Development Corp. somewhere in New England. Present plans for plant include two large electric furnaces and a rolling mill. ODM's approval is contingent on a site selection which meets ODM industry dispersal requirements.

▲

PEOPLE who think that opportunities are scarcer than they were in the old days should reflect that 60 per cent of the duPont products were not in existence 20 years ago.

▲

AISE members in the St. Louis area are actively promoting the formation of a district section. Interest and enthusiasm are high, and a group has been organized and programs planned. When they have obtained a larger membership, they plan to ask the Association to establish a section there.

▲

EXCEPT for relatively few exceptions, today's steelworkers must be of a different breed than their predecessors. Statistics now show that wage earners in the steel industry have an average of exactly two dependents.

The exceptions? — Well, one man claimed 16 exemptions for income tax purposes.

▲

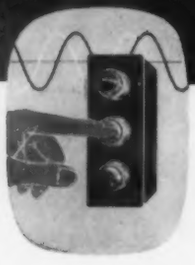
IT'S easy to keep an expense account. The hard part is to make it tally with the cash.

▲

UP to this writing, your editor has walked through about half of the steel producing capacity west of the Mississippi River. One of the principal problems of these plants is the production of a wide variety of items of relatively small individual tonnages. This problem calls for mills of a flexible nature which can be changed easily. It is met with ingenuity not often found in the large eastern plants. Many of the western rolling mills are quite old, but they are operated to give some rather astonishing production rates.

▲

A correspondent tells us that many men make money but money never makes men. No, but it's a big help in this life if one's ancestors were of good stock, or at least owned plenty of it.



AUTOMATION STARTS WITH WESTINGHOUSE MOTORS AND CONTROLS

How Westinghouse Motors and Controls answer the need for dependable auxiliaries in a blooming mill...

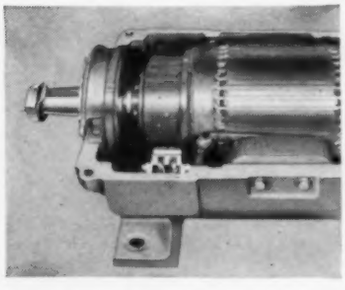
Greater speed, precision and stamina are typical advances made in modern steel plant operations through automatic, integrated control and skillfully engineered motors.

There's the record set in reversing the blooming mill at the Jones & Laughlin Steel Corporation. Here is an example of the performance of Westinghouse Main Drive Equipment backed up by the performance of Westinghouse Motors and Controls applied to the auxiliary drives.

The low-inertia armature of the Westinghouse Type MC Mill Motor for auxiliary drives allows starting, stopping and reversing under heavy loads in minimum time. As a result, low current peaks and energy consumption are assured. Better commutation, heavier axle steel shaft and higher maximum safe speeds are but a few of the many other advantages from applying Westinghouse Mill Motors.

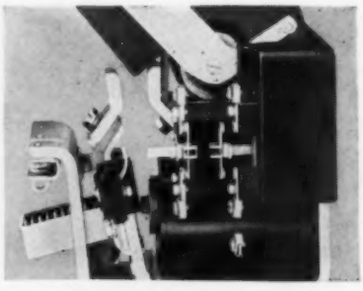
Controls for auxiliary drives have been designed to give the maximum protection with high-speed operation. The best in control devices is used. For example, with Westinghouse Type M Contactors at work in your mill, you're assured of millions of trouble-free make-breaks even on the toughest jobs. Knife-edge bearings on Type M Contactors eliminate friction . . . reduce wear. A strong kickout spring delivers faster action for rapid, cyclic operations. Special arc chambers snuff out harmful arcs, thereby increasing contact life. Interlocks, mounted directly on the contactor frame, enable you to get any precise sequencing required.

Investigate Westinghouse Mill Motors and Controls. Ask your local Westinghouse salesman for booklet B-5650, *Westinghouse Mill Motors and Control Equipment,* or write to: Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-21786



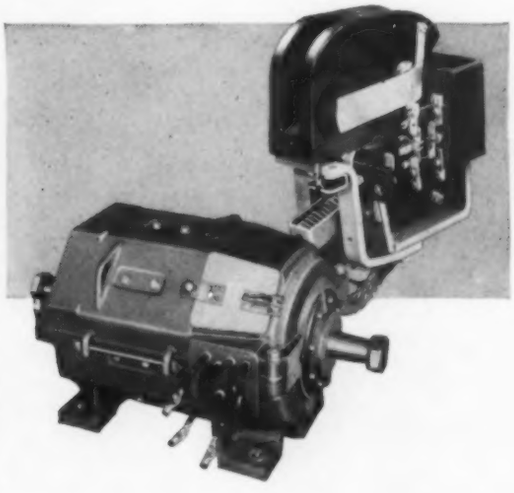
Heavy-duty Armature

Core is accurately bored and pressed on axle steel shaft eliminating quill. Coils are held in slots with wedges, rather than conventional bands, permitting safer operation.



Unit-mounted Interlocks

Electrical interlocks are mounted directly on the contactor frame and maintain correct alignment with the moving armature. No troublesome operating linkages are required.

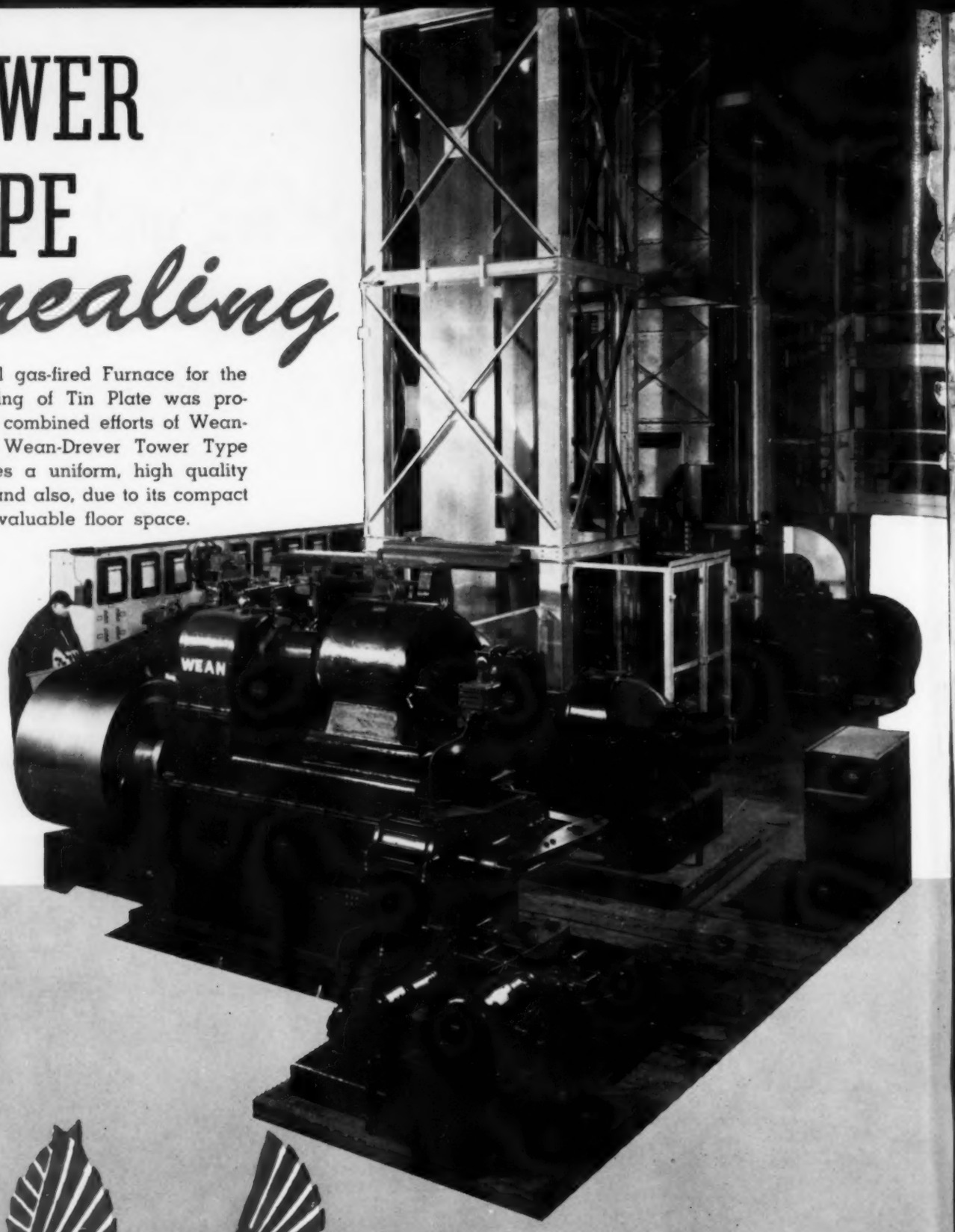


YOU CAN BE SURE...IF IT'S Westinghouse

TOWER TYPE *Annealing*

The first successful gas-fired Furnace for the continuous annealing of Tin Plate was produced through the combined efforts of Wean-Drever engineers. Wean-Drever Tower Type Annealing produces a uniform, high quality annealed product and also, due to its compact design, conserves valuable floor space.

Thus Wean engineers again have proven their leadership as Specialists in Sheet, Tin and Strip Mill Equipment.



by The

WEAN ENGINEERING *Company, Inc.*

WARREN, OHIO

T. J. ESS, *Editor*
I. E. MADSEN, *Associate Editor*
ALBERT W. ERICKSON, JR., *Production Manager*

Board of Directors

PRESIDENT
J. L. YOUNG
Vice President—Engineering
United States Steel Corp.
Pittsburgh, Pa.

FIRST VICE PRESIDENT, E. L. ANDERSON, *Superintendent Electrical Department,* Bethlehem Steel Co., Johnstown, Pa.

SECOND VICE PRESIDENT, JOHN H. VOHR, *General Superintendent,* Gary Steel Works, United States Steel Corp., Gary, Ind.

TREASURER, W. H. COLLISON, *Assistant General Superintendent,* Blast Furnace Division, Great Lakes Steel Corp., Ecorse, Mich.

SECRETARY, J. D. O'ROARK, *Assistant Manager, Service and Maintenance,* Weirton Steel Co., Weirton, W. Va.

PAST PRESIDENTS: A. S. GLOSSBRENNER, *Vice President Operations,* Youngstown Sheet and Tube Co., Youngstown, Ohio.

I. N. TULL, *Electrical Superintendent,* Republic Steel Corp., Cleveland, Ohio.

HONORARY DIRECTORS: JAMES FARRINGTON, *Special Assistant to Chief Plant Engineer,* Wheeling Steel Corp., Steubenville, Ohio.

C. L. McGRANAHAN, *Technical Assistant to Works Manager,* SOLLAC, Seremange (Moselle), France.

L. F. COFFIN, *Assistant General Manager,* Bethlehem Steel Co., Sparrows Point, Md.

DIRECTOR-AT-LARGE: L. LARSON, *Chief Engineer,* Republic Steel Corp., Cleveland, Ohio.

DIRECTORS: C. G. MARSHALL, *Superintendent of Construction, Engineering — Raw Materials Division,* Tennessee Coal and Iron Division, United States Steel Corp., Fairfield, Ala.

A. M. CAMERON, *Superintendent Rolling Mills,* Atlas Steels Limited, Welland, Canada.

F. A. JOHANTGES, *Electrical Engineer,* International Harvester Co., Wisconsin Steel Works, Chicago, Ill.

W. W. BENTZ, *Superintendent Maintenance,* McDonald and Upper Works, United States Steel Corp., McDonald, Ohio.

ROBERT SERGESON, *Chief Metallurgical Engineer,* Rotary Electric Steel Co., Detroit, Mich.

J. S. MORRIS, *Supervisor of Construction,* Lukens Steel Co., Coatesville, Pa.

EMIL KERN, *Vice President in Charge of Engineering,* Allegheny Ludlum Steel Corp., Brackenridge, Pa.

L. V. BLACK, *Superintendent Electric Department,* Bethlehem Steel Co., Bethlehem, Pa.

E. T. W. BAILEY, *Chief Combustion Engineer,* The Steel Co. of Canada Limited, Hamilton, Canada.

T. M. FAIRCHILD, *Assistant to General Manager,* Franklin Mills, Bethlehem Steel Co., Johnstown, Pa.

D. W. LLOYD, *General Superintendent,* Indiana Harbor Works, Youngstown Sheet and Tube Co., Indiana Harbor, Indiana.

F. E. ROBINSON, *Assistant Division Engineer,* American Steel and Wire Division, United States Steel Corp., Cleveland, Ohio.

R. A. KRAUS, *Assistant Maintenance Superintendent,* Republic Steel Corp., Chicago, Ill.

Managing Director
T. J. ESS
Empire Building
Pittsburgh, Pa.

Iron and Steel ENGINEER

NOVEMBER, 1953 VOLUME XXX NUMBER XI

In This Issue

Patent Reviews — By Melvin Nord, Patent Attorney, Detroit, Mich..... 23

Symposium on Open Hearth Availability —

Fuel and Its Usage — By Edward E. Callinan, Combustion and Refractory Engineer, Alan Wood Steel Co., Conshohocken, Pa..... 55

Furnace Rebuilding — By W. H. Shure, Assistant Supervisor of Maintenance, Mechanical Maintenance Dept., Bethlehem Steel Co., Sparrows Point, Md..... 61

Furnace Design and Brick Work — By H. C. Paxson, Assistant to Superintendent, Refractories and Fuel, Lukens Steel Co., Coatesville, Pa..... 66

Air Filters in Rotating Electrical Equipment Cooling Systems — By Fred C. Reutenauer, Design Engineer, Elliott Co., Ridgway, Pa..... 71

Flying Shears for Billet, Bar and Rod Mills — By J. H. Hitchcock, Director of Research and E. S. Murrah, Electrical Engineer, Morgan Construction Co., Worcester, Mass..... 80

Pollution Control Can Be Realistic — By John E. Kinney, Sanitary Engineer, Ohio River Valley Water Sanitation Commission, Cincinnati, Ohio.. 91

Current AISE District Section Meeting Notices..... 97

Flexible Connection Reduces Crane Runway Maintenance — By James A. Evans, Consulting Engineer, Massillon, Ohio..... 98

AISE District Secretaries 1953-1954..... 102

Expansion at the Steel Co. of Wales — By T. J. Ess..... 105

Large Electric Furnace of the Future May be Six-Electrode Unit — By Frank W. Brooke, Pittsburgh, Pa..... 123

Low Frequency Indication Coils Shorten Billet Heating Time..... 130

Economical Refractory Bottom Developed for Reheating Furnaces..... 135

Blooming Mill Built for Detroit Steel..... 140

Date-Line Diary..... 159

Industry News..... 165

Personnel News..... 179

Equipment News..... 199

Index to Advertisers..... 221

Published Monthly by

ASSOCIATION OF IRON AND STEEL ENGINEERS
1010 EMPIRE BUILDING
PITTSBURGH 22, PENNSYLVANIA

Statements and opinions given in articles and papers appearing in "Iron and Steel Engineer" are the expressions of contributors, for which the Association of Iron and Steel Engineers assumes no responsibility.

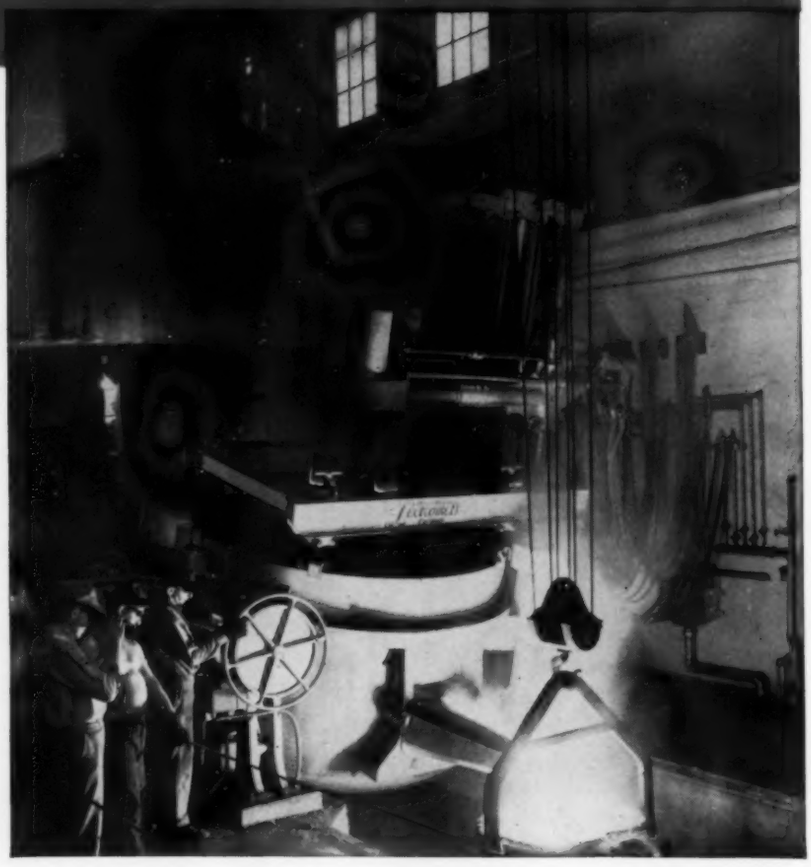
Copyright, 1953, The Association of Iron and Steel Engineers.

Indexed by Engineering Index and by Industrial Arts Index

Single Copy Foreign Prepaid $2.00 Single Copy $1.50
Subscription price in U. S. and Canada (U. S. funds)..... $ 7.50 per year
Subscription price in foreign countries..... $10.00 per year

PLASTIC BINDING U. S. PATENT NO. 1970285 LICENCE NO. 120

if you judge a furnace on performance...



For 32 years Empire Steel Castings, Inc., has depended on this Lectromelt Furnace. Rated at 1½ tons, it consistently pours 2½ to 3-ton heats.

New 5-ton Lectromelt Furnace at Empire pours a high-quality stainless-steel heat.

A rugged, 32-year-old Lectromelt* Furnace still works full time at Empire Steel Castings, Inc., Reading, Pa. Empire says, "It's as good as the day it started. Better, in fact, because we found we could pour additional power to it, so we get heats out faster than we first dared to."

On the basis of the performance and reliability of Empire's old furnace, they recently bought a new 5-ton, top-charging Lectromelt. Now they get much closer temperature and chemical control. And new, pin-point analysis control enables them to duplicate uniformity and high grade of molten metal in lot after lot of stainless.

Lectromelt Furnaces will boost your performance record and add to the quality of your metal. Write for catalog #9 describing them in detail. Pittsburgh Lectromelt Furnace Corporation, 310 32nd Street, Pittsburgh, Pennsylvania.

Manufactured in . . . CANADA: Lectromelt Furnaces of Canada, Ltd., Toronto 2 . . . ENGLAND: Birlec, Ltd., Birmingham . . . FRANCE: Stein et Roubaix, Paris . . . BELGIUM: S. A. Belge Stein et Roubaix, Bressoux-Liege . . . SPAIN: General Electrica Espanola, Bilbao . . . ITALY: Forni Stein, Genoa. JAPAN: Daido Steel Co., Ltd., Nagoya

*REG. T. M. U. S. PAT. OFF.

MOORE RAPID

WHEN YOU MELT... *Lectromelt*

Symposium
ON
Open Hearth Availability

. . . . ingenuity on the part of steel plant supervisors in increasing open hearth availability has been as important a factor in increased steel production as additional furnace units . . . .

"FUEL AND ITS USAGE"

By EDWARD E. CALLINAN

Combustion and Refractory Engineer

Alan Wood Steel Co.

Conshohocken, Pa.

▲ FUELS and furnace life frequently are in opposition to each other, because from the consideration of the over-all economics of open hearth operation, it sometimes may be, within limits, good economics to allow your fuel practice to shorten furnace life. You will note that this statement is qualified by the phrase: "Within limits." I do not mean to infer that it is wrong to increase availability. I do mean that it may not be helpful to increase availability at the expense of certain other factors, overall production cost and production volume, for example.

Hence, some of these comments may sound like heresay when presented as part of our symposium subject. Furnace availability may be defined in several ways. A definition recently presented is: "The per cent of time a furnace has fuel on during the year. It is the percentage figure obtained by dividing the fuel—on time by the 8760 hours in a 365 day year."

Such a figure has merit. However, if you are or ever were an operating man you know the boss does not phone you to inquire about the per cent availability, at least not until he first has asked how many tons you tapped yesterday and how many you are going to tap today. To be practical, the term: "Rate of production" has to be included in the availability equation. Both terms will be intermingled in my remarks.

This discussion should be further prefaced by stating that little will be said about better fuels. Such a topic would include items such as blended fuels, enriched fuels, synthetic fuels, theoretical properties of fuels, etc. The literature of the past 10 to 15 years covers such matters to the extent that there is little I am able to add.

It is heretofore, more practical to discuss a few of the more commonplace features and problems of open hearth fuels and their usage, some of which we may sometimes neglect or whose presence we may fail to recognize.

Returning to the earlier remarks on availability and production, the following data will illustrate their relationship. Figure 1 shows performance data of an 8-furnace shop for the year 1952. Please note that actual values are not being shown. The variation of the bar heights represents only a comparison between furnaces. Let us look at furnace No. 1 for example. This furnace is, without question, the best furnace in the shop. Note in the comparison in the lower left corner that it had the next to poorest availability, but with respect to production it was superior to the other furnaces. It had the highest total production for the year, and the highest rate on tap-to-tap time basis. Also it had the longest operating life in terms of heats per campaign. Note also it had the next to lowest cold charge time, the significance which will be discussed later.

As opposed to the data of this furnace, furnaces No. 7 and No. 8 are the next two best furnaces and they have high availability ratings. No. 4 furnace is the lowest and slowest tonnage producer, and it ranks fifth in availability. The point is that availability alone does not necessarily indicate the best or most favorable conditions.

These differences in performance are not produced to any appreciable extent by differences in fuels, fuel systems, burners, atomizing agents, or other fuel features. Nor can they be attributed to the varying efficiency of repair operations. These are relatively uniform for all furnaces. Without going into great detail, it can be said that some of the principal factors which do help effect these differences are the more or less marked differences in furnace design, including straight and sloping backwalls, checker capacity, flue system and valves, variation in amount and type of instrumentation and automatic control, forced and natural draft, and last but not least, the furnace location and spacing on the open hearth floor as they affect charging time. The three best furnaces, Nos. 1, 7 and 8 have the three shortest times for cold charging and for complete charging. Also, the location of the cross-over tracks from the stack yard to the main charging track is a factor in charging time.

An important property of liquid fuels and of coke oven gas which can affect both availability and rate of production is sulfur content. In the case of fuel oil, in recent years there has been a steady trend towards higher sulfur contents. Consideration of the sources of supply and the amounts and types of products being extracted from crude oil indicates that no reversal of this trend can be expected in the near future. The best that can be done, then, is to know the sulfur content of the fuels you are using, and endeavor to control or minimize any swings or changes in the total sulfur values of the fuel sent to the furnace.

Sulfur is of importance not only because it must be (usually) controlled to low limits in the final product, but also because it can affect the control of such items

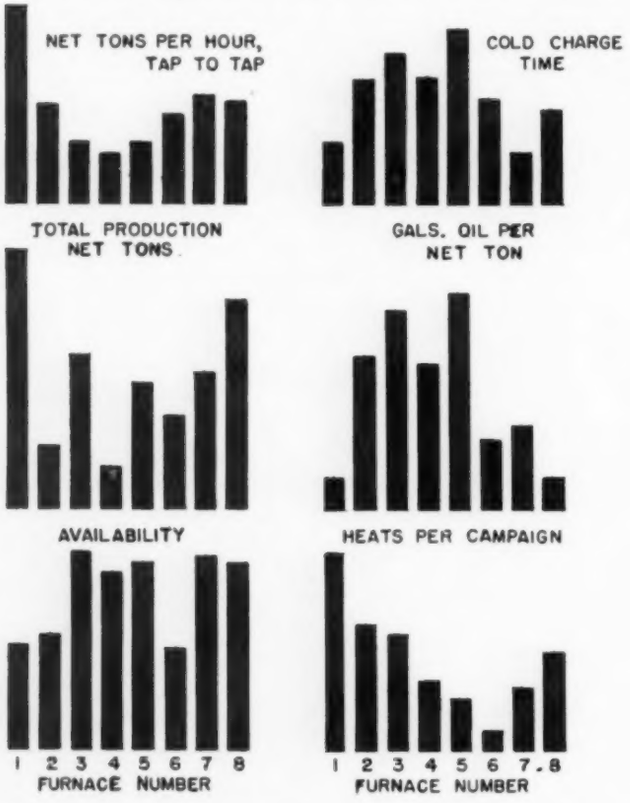

NET TONS PER HOUR, TAP TO TAP
COLD CHARGE TIME
TOTAL PRODUCTION NET TONS
GALS. OIL PER NET TON
AVAILABILITY
HEATS PER CAMPAIGN
1 2 3 4 5 6 7 8
FURNACE NUMBER
1 2 3 4 5 6 7 8
FURNACE NUMBER

Figure 1 — Charts give a comparison of various operating data by furnaces.

as slag volume, basicity, fluidity, and temperature. According to most investigators, temperature does not directly affect the chemistry of desulfurization but does increase the rate of desulfurization by more rapid solution of lime. It is obvious that by minimizing frequent and extreme swings in fuel sulfur content, the open hearth operator can more accurately set up the metallic and basic components of his charge so as to get an economical charge and favorable production rate without requiring excessive time for sulfur removal with consequent effects on furnace and availability.

Some recent tests on oil obtained from two different sources, which are mixed and used in open hearths, gave the following results: Source A averaged 0.972 per cent sulfur ranging from 0.82 to 1.19 per cent, or a total range of 0.37 per cent. Source B averaged 0.597 per cent sulfur ranging from 0.47 to 0.88 per cent or a total range of 0.41 per cent. The total range of the two sources was from 0.47 to 1.19 per cent or a range of 0.79 per cent. If, in the oil introduced to the furnace there was frequent and sudden variation of even 50 per cent of these extreme values, furnace life, availability, and production, not to mention the open hearth operators' nerves, would suffer. Actually, in this case with the proportions of the two oils used, the average sulfur at the furnace varied by only 8 to 12 points. This is the result of such commonplace factors as proper scheduling of deliveries, and mixing or blending in adequate sized storage tanks, so commonplace that it hardly seems worth mentioning until one visualizes what can happen if through error or necessity, some plus 2 per cent sulfur oil, normally used in the mill furnaces, gets into the open hearth system. It has happened.

Not too long ago there was some doubt that sulfur from the fuel was picked up in the open hearth bath. This opinion was, perhaps, based on the lower sulfur fuels with which we once were blessed. At low sulfur levels, the amount of pick-up is negligible. Brower and Larsen, U. S. Steel Corp., in a paper published in the December, 1951 issue of the Journal of Metals, present data indicating that as the sulfur content of the fuel increases, a higher percentage of it is transferred to, or absorbed, by the bath. From their data, it appears that at a fuel level of 4 to 5 lb of sulfur per amount of fuel required per ton of steel, from 4 to 7 per cent may be transferred to the bath. This was of sufficient magnitude to raise the ladle sulfur by 0.006 per cent or more.

A more striking picture of the relation between sulfur content of the fuel and pick-up in the bath is illustrated by the following experience which occurred in an acid steel shop using fuel oil in 60 ton, 100 per cent cold charge furnaces. There were no significant changes in the charges during the time which is covered by Figure 2 and the trends shown are considered to be due entirely to the change in sulfur content of the fuel.

As can be seen, final sulfur values being obtained were above those allowed by specification. This was caused by both gradual increase in sulfur value of the fuel oil and by the lack of sufficient low sulfur scrap, with which to "sweeten" the poor grade scrap available.

Under the conditions prevailing the only solution was to pay a premium price for a lighter, lower sulfur oil and blend it with the regular oil to produce a mixture of sufficiently low sulfur content to keep the metal within specifications. The curves show the changes of sulfur content of the fuel and of the ladle sulfurs as this blending was begun. As this blending operation was started, the mix was allowed to run down to practically 100 per cent light sulfur oil. The curves of the data tell the story. Within the ranges shown it is correct to say that for every 0.1 per cent reduction of sulfur in the oil, a reduction of 0.001 per cent in ladle sulfur was obtained. During this experience, it also was found that after the charge was melted down and covered with a blanket of slag, there apparently was no further pick-up of sulfur from the fuel. It is of interest to know that today this shop is using a 50-50 mixture of light oil and Bunker C and successfully holding the ladle sulfur under 0.040 per cent.

The problem of controlling sulfur is difficult because so little can be done with the individual fuels. As previously indicated, fuels may be mixed to produce a more

constant and/or lower average sulfur content. Or it may be feasible to use a low sulfur fuel during the melt-down period and then change to a higher sulfur fuel. Sulfur pick-up from the fuel can be reduced by minimizing the amount of light scrap used. Apparently the pick-up is a function of the amount of surface area exposed to the flame and gases. Also, some investigators have presented evidence that high residual copper content of the scrap results in a greater pick-up of sulfur from the fuel.

In the case of coke oven gas, it is possible to remove a major portion of the original sulfur content. While the equipment investment cost is rather large, present day

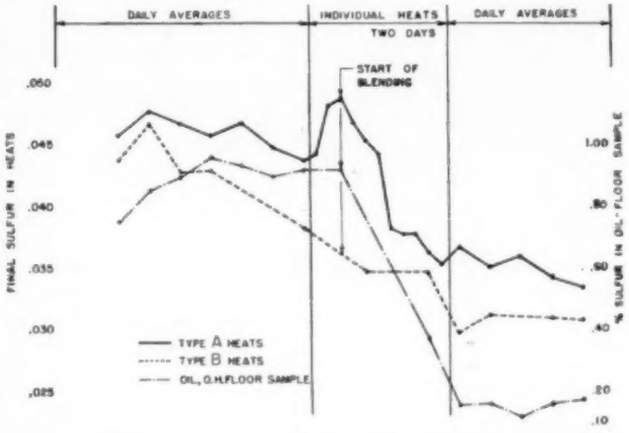


Figure 2 — Curve shows effect of blending high and low sulphur oils.

operating costs for a relatively small purification plant to produce coke oven gas from 400 grains of sulfur per 100 cubic feet down to 50 grains may be as low as 8 mils per 1000 cubic feet of gas.

Figure 3 shows how much such a sulfur reduction can mean. It shows the pounds of sulfur contained in fuels in several different cases. All cases are based on a theoretical figure of 30 gallons of 150,000 Btu oil, or its equivalent, required per ton of steel. This figure illustrates the following points:

1. B versus C. The use of 60 per cent of unpurified coke oven gas as a substitute for 2 per cent sulfur oil provides no appreciable reduction in total sulfur in the fuel.
2. D versus A. The substitution of 60 per cent of unpurified coke oven gas for 0.90 per cent sulfur oil results in a 70 per cent increase in total sulfur.
3. E versus A. The substitution of 60 per cent of purified coke oven gas for 2 per cent sulfur oil results in a total sulfur content only slightly above that obtained from 100 per cent of 0.90 per cent sulfur fuel oil.
4. F versus A. If purified coke oven gas is substituted for 60 per cent of the 0.90 per cent sulfur oil the total fuel sulfur content is reduced by approximately 40 per cent.

When it is recalled that there are predictions that in the future our oil will be at 2 per cent sulfur and higher, it can be seen that some of the recent trends which have forced plants to use a larger percentage of coke oven gas in the open hearths may not be a nuisance or a calamity as we might think. It might be the answer to a critical problem, provided the gas is desulfurized and we learn how to burn it effectively.

Summarizing, combating high sulfurs in the open hearth can be detrimental to high furnace availability. The fight to eliminate high sulfur requires time at high temperature which in turn produces additional wear and tear on the furnace brick and on the bottom. Not only is it important to minimize the amount of sulfur introduced in the furnace, but of at least equal importance is the need to control the sulfur input at a known level with narrow limits. If this is done, then even with a comparatively high sulfur input, the open hearth department can so adjust their charge and practices so as to effect the necessary sulfur removal without causing undue abuse to the furnace.

As stated earlier, the commonplace factors involved in fuels and their usage can have a direct bearing on furnace life and availability. This can be illustrated by consideration of the reversal of open hearths. Without going into a discussion of what is the best reversal principle, reversal time, etc., it is evident, nevertheless, that proper reversal can effect furnace availability and production since the operation affects time, temperature, pressure, heat loss, etc. Based on 95 per cent availability and 12-minute reversal cycles, a furnace reverses about 41,000 times a year, and it can be seen that a few seconds saved each reversal cycle can increase operating efficiency. But of equal or greater importance than the time required for reversal is the potential heat loss which may occur at this time. Several small details are worth mentioning in this connection. The mode of operation of the furnace pressure controller is of im-

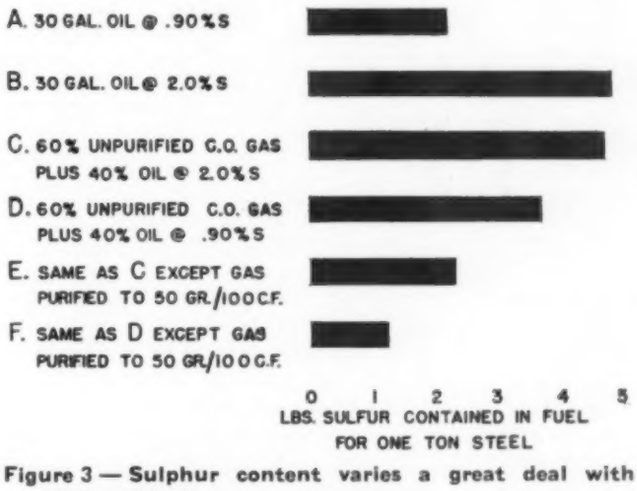

A. 30 GAL. OIL @ .90% S
B. 30 GAL. OIL @ 2.0% S
C. 60% UNPURIFIED C.O. GAS PLUS 40% OIL @ 2.0% S
D. 60% UNPURIFIED C.O. GAS PLUS 40% OIL @ .90% S
E. SAME AS C EXCEPT GAS PURIFIED TO 50 GR./100 C.F.
F. SAME AS D EXCEPT GAS PURIFIED TO 50 GR/100 C.F.
0 1 2 3 4 5
LBS. SULFUR CONTAINED IN FUEL FOR ONE TON STEEL

Figure 3 — Sulphur content varies a great deal with different fuels.

portance during the reversal process. With the ordinary or basic controller, when the reversal cycle is started, the controller starts closing the stack damper as the fuel and air are cut off the furnace, Then as the fuel and air are admitted to the other end, the damper has to move from the closed or nearly closed position to a wide open position in an attempt to counteract the sudden build-up of pressure over the hearth. In other words, it tends to hunt, alternately causing the furnace to blow or suck in excessive air until the hunting action settles out. A simple practice which eliminates all this is to have the first impulse of the reversal operation automatically lock the pressure controller in its

operating position. This is not unlocked until the reversal operation is virtually completed. The pressure controller then has to move only enough to compensate for any difference in draft resistance between the two ends of the furnace. Proper usage of this control feature, which is obtainable from all automatic equipment suppliers, will tend to decrease the true reversal time and reduce fuel consumption and air infiltration.

Another factor is the location of the fuel reversing valve, and what happens to the fuel lying between it and the burner. In the case of oil firing, if the cut-off valve is at the control stand there may be some 50 to 100 ft of pipe filled with fuel between it and the burner. When the fuel valve is closed this oil will continue to flow until the line pressure is dissipated or until the steam purging the burner has, in effect, sucked it out of the line. Also, when the burner is turned on after the next reversal, this line must be filled up or the pressure built up to the desired value. A more effective means of reversing is to locate the actual cut-off valve (and the regulating valves) at the ends of the furnace so as to minimize the length of lead to the burner.

Even when the cut-off valve is located at the end of the furnace, the fuel line from the control stand to this location is a dead end line, no circulation occurring when the burner is not firing. If this line is not heated, say by a tracer line, under some conditions it may lose sufficient temperature and become so viscous as to result in low flow rate and poor atomization when firing is resumed.

On the other hand, the tracer line can subject this dormant oil to enough temperature to cause partial varporization, particularly of any light ends which might be in the fuel. This can cause puffing and pumping of the oil when the furnace is reversed with consequent loss of reversing and thermal efficiency. The design of this section of the fuel system must be such that the temperature in this section can be adjusted. Usually hand adjustment is satisfactory. Occurrences such as those cited are more likely to occur when a change in fuel grade and viscosity is made unless the temperature is adjusted accordingly.

Long oil line systems with tracers can result in considerable variation in temperatures in the system. In the average size shop it is good practice to provide individual oil heaters for each furnace.

Adequately sized lines in the main fuel oil circulating system and ample pumping capacity should not be neglected. With increasingly higher fuel input rates, it sometimes happens that the furnace furthest from the pump can not get all the oil it wants at times when the other furnaces are consuming at high rates. Pump designers recommend that at least twice, and preferably three or more times, the maximum consumption should be circulated to assure even pressure conditions. Again, the temperature of the fuel at the pump should be controlled not only for economy and uniformity, but also because some types of pumps develop excessive slippage if the oil becomes too hot and thin.

In speaking of fuels and furnace availability, the connection with air infiltration is obvious. A German investigator has stated that in an ordinary furnace system, one one-thousandth of the outer surface may consist of leaks and at a mean pressure difference of 0.02-in. water, the amount of air entering the system may be between 10.5 to 21 cu ft per hr per sq ft of surface. Expressed another way, at a pressure difference of 0.01-in. water, 95 cu ft of air per hr can pass through a one sq in. opening. Today everyone, I hope, is doing everything possible to reduce air infiltration. In this program there is one particular place which should not be neglected and which can not be sealed up with cement or insulation. I refer to the furnace doors. Assuming five doors, each 60-in. wide, open one inch at the bottom, then according to the figure quoted obove that is, at a pressure difference of 0.01-in water, over 28,000 cu ft of cold air per hr enters the very place where maximum temperature is so necessary. This condition sometimes is prevalent from the time the heat is tapped and the refractory banks in the doors have been removed, until they are replaced when the cold charging is completed. Either the operator does not close the doors so that they sit on the sill plates, or in cleaning off the sill, refractory is allowed to remain at the outer ends of the sills so that the door sits on it and effectively remains open 2 to 4-in. across its entire width.

This condition may exist for there or more hours in some cases. It has several bad results. It can be noted that the scrap charge at the front of the furnace is distinctly colder and melts more slowly than that in the center and back of the furnace, This cold infiltration air affects flame temperaure and checker efficiency. According to some investigators such infiltration may be harmful to good roof life, for as the cold air enters the furnace at high density as compared to the furnace gases, it pushes inward and then upward as it acquires heat and becomes lighter. This tends to push the flame and gases upwards and towards the back of the furnace, and thus may accelerate attack on the back section of the roof. In any event, in-attention to proper sealing of doors can render ineffective an otherwise well intentioned "reduction of infiltration" campaign.

The mention made above of flame position and flame direction could serve to open up the very broad subjects of flames, their temperature, heat transfer capacity, burners, oxygen enriched flames, etc. These subjects have been well covered in the literature of the past ten years and such data will not be repeated at this time. However, there is one point in connection with the subject of flame control which ordinarily is not sufficiently emphasized. Regardless of the type fuel, burner, pressures and other factors which may be established as best for a particular furnace, a most critical factor is the maintenance of the lines of the furnace between the uptake and the edge of the bath. The efficiency of combustion and the effect of fuels and flames on furnace life involves the relationship between the size, shape, slope and details of what Buell calls the throat of the furnace, usually the section between the uptake bridgewall and the roof knuckle or the edge of the bath.

This is the primary mixing chamber of the furnace. Given a desirable design of this section, it must be maintained properly. Monkey walls, if used, should not be allowed to erode away to nothing. They should be maintained by placement of refractory, and if necessary, by suitable water cooling built into them. The slope, smoothness and profile of the base of the throat,

and the height of the bridgewall should be maintained at the desired optimum design. Proper maintenance of the lines of this section of the furnace will have as much to do with the control of flame size, position, and intensity, and on furnace life and availablility as almost any other single factor of fuels and burners.

Without discussing the comparative merits of the various agents which may be used to atomize liqu'd fuels, several points on the use of steam for atomization are worth mentioning. There still are well founded differences of opinion as to the value of highly superheated steam. However, it is evident that if there should be any tendency for wet steam to get into the burner, then superheating to the extent of eliminating this condition certainly is beneficial.

A second point is, that after taking steps to get good dry steam, and oil heated to the proper low viscosity, the mixture sometimes is then made to flow some 6 to 10 ft through the burner in a pipe which is completely water jacketed. The use of a dry burner with suitable "dog house" cooler or a dry pipe design within the burner cooler will provide a more satisfactory condition of the fuel-steam mix at the burner tip.

Kraner and Jewart, in a recent paper, "Heating Up Furnaces After Rebuilding," 1952 Proceedings AISE, p 851, exemplify a very specific means of increasing furnace availability. This excellent paper includes a description of benefits derived from heating up the upstairs section of the furnace before the repair work downstairs has been completed. This successful practice of heating separate sections of the furnace brings to mind a thought once advanced by a very good and very practical open hearth operator. He noted that the operations after tapping eventually result in a significant drop in checker temperature and that quite a few hours of hard firing are required to bring these temperatures back up to the higher levels. The operations after tapping may require that the fuel be turned off, the doors opened, charging interference with the flame, and other conditions harmful to good combustion conditions. Since these cannot be avoided, this operator's thought was to provide auxiliary burners in the slag pockets or in the checker chambers which could be used at this time to keep the checker temperatures at high levels. This would then provide air at maximum temperature at the time it could be used to best advantage —at maximum fuel flow when a sharp melting flame is required and when roof temperature is low and high fuel rates and high flame temperature can be used with safety to the comparatively cold refractories.

This idea may not be workable, but fundamentally it is no more radical than the successful practice Kraner and Jewart describe, heating the upstairs part of the furnace while the bricklayers and laborers are still working downstairs. Unless we are to merit the old criticism that the only real open hearth improvement has been the adoption of the rubber tired wheelbarrow, we should, as Kraner and his fellow workers have done, be willing to make radical departures from routine procedures and conventional viewpoints.

There is one other factor which must be included in any discussion of furnace availability. This is the personnel factor, and from the standpoint of fuel usage this is the furnace personnel. Buell, in evaluating successful open hearth operations assigns 40 per cent of the credit to the personnel.

A principle of personnel management, which today is generally accepted as an axiom rather than a theory, is that resistance or lack of cooperation in dealing with new ideas or practices is due far less to innate bullheadedness than it is to lack of knowledge and instruction on the problems and goals before us.

To cite a few examples, the position and cleanliness of the burners must be adjusted and checked frequently. The crew should know the advantages of getting the doors banked as quickly as possible and have them closed tightly. The first helper should be after the combustion man the minute he notices the fuel controls are sluggish and not coming on as quickly as desired after reversal. He should be complaining if the slag pocket bulkheads are not sealed up immediately after the rebuilt furnace is put in operation. In turn he and his crew deserve proper support from their supervisors. Training, consultation and easy access to performance data ("How did yesterday's heat finish up?") must be available to them. Just as the taxi companies have learned that the cabbie who is given the same cab each day will take better care of it than if he drives a different one each day, so should the furnace crews, in so far as possible, be kept on the same furnace for the length of its campaign. They learn its idiosyncrasies and have more opportunity to try to circumvent them.

A full complement of the latest automatic control and equipment will not of itself produce the optimum fuel and time practices we desire. They must be supplemented by personnel equipped with a healthy mental attitude, and who are smart enough to know they and their supervisors are all working toward the same fundamental objective—to make good quality steel at a profit.

As stated at the beginning, these remarks have been concentrated on some of the smaller, more commonplace points of operation and control, chiefly as a reminder that they should never be overshadowed or made forgotten by the larger, more spectacular methods and devices, for both, the large and the small, are essential if optimum results are to be reached.

DISCUSSION

PRESENTED BY

LOUIS F. COFFIN, Assistant General Manager, Bethlehem Steel Co., Sparrows Point, Md.

R. R. FAYLES, Staff Assistant to Manager, Fabrication and By Product Steel Division, Lukens Steel Co., Coatesville, Pa.

E. E. CALLINAN, Combustion and Refractory Engineer, Alan Wood Steel Co., Conshohocken, Pa.

M. E. CARSON, Chief Engineer, Bethlehem Steel Co., Steelton, Pa.

MATTHEW K. MORRIS, Assistant Superintendent No. 2 and 4 Open Hearth, Bethlehem Steel Co., Bethlehem, Pa.

H. W. POTTER, Assistant to Open Hearth Superintendent, Lukens Steel Co., Coatesville, Pa.

L. F. Coffin: It has been the practice of many shops, to measure at each rebuild the exact condition of the

new brick work that is installed, so that every furnace may be brought back to its drawing dimensions and kept to that point. This is a valuable consideration so that we do not get off standard.

This question of furnace availability is one of the most important facing the steel industry today, as far as open hearth practice is concerned. Tremendous strides have been made in the last few years in increasing the tons per year from existing furnaces.

R. R. Fayles: The ever-recurring problem of sulphur in fuel is one we talk about every year. We discuss it but find the future holds little promise. We heard a fellow from Gulf Oil last year tell us that as we become more dependent on Venezuelan and other foreign oils that we are going to be plagued with 2 and 2½ per cent sulphur in Bunker C oil. I have been wondering if anyone might know whether there is any economical method of removing the sulphur from the oil before we ever get it in the shop, and then we would not have to worry about it.

Edward E. Callinan: To answer Mr. Fayles' question as to whether there is an economical method of sulfur removal from fuel oil; to my knowledge there is no such method available at the present time. However, I understand that laboratory research has produced means of effecting a partial reduction. It is encouraging to know that such efforts are being made and that some progress has resulted. Eventually such work may result in a method which we can afford to use.

M. E. Carson: Being a representative of the engineering department, it is more or less our duty of course to coordinate or to get ideas from the operating people, from the combustion people and from the brick people, and come up with a design in which there would be an optical illusion so that each will be satisfied.

Seriously, though, many times in the open hearth rebuild program there are small changes made which have serious effect on the production of that furnace which are sometimes lost on the next rebuild, so I would like to recommend that the operating people and the people who work in the field keep a close contact with the engineer department in order that they may have their drawings up to date so that any improvement, no matter how small can be recorded and incorporated in other rebuilds.

Matt Morris: I would like to ask the author if he could tell me of their system of blending the high and low sulphur oils.

Edward E. Callinan: First I should state that the blending described is not done at the plant with which I am now associated. It did occur in a five 60-ton acid open hearth shop. Here there were several large tanks from which the oil was pumped to smaller tanks near the open hearths. Most of the oil was being delivered by truck rather than by tank car, so when the sulfur situation I decribed demanded action, the trucks of light oil were pumped directly into the open hearth tanks. When this was first done, the light oil was added until that delivered to the furnaces was practically 100 per cent light oil. This was done, in spite of the cost, to determine the ultimate effect of reducing the oil sulfur content from 1-1.25 per cent down to 0.12-0.15 per cent. A 50-50 mix later was found to give the required results and this was made the standard mix.

Later, a blending tank was added adjacent to the regular open hearth tanks. Here the light oil was mixed with the heavy pumped down from the main storage tanks, and then introduced into the furnace system. No problems of stratification or inadequate mixing were encountered, so no agitation devices were required. The agitation obtained when pumping into the tank and that produced by the oil from the return line of the oil system was sufficient to produce good mixing. Oil samples taken on the open hearth floor showed the sulfur content being held within narrow limits. Perhaps we were fortunate in this respect for it is known that certain grades of oil will not blend satisfactorily. This occurs more frequently, I understand, when attempting to blend fuel oils with certain topped tars.

H. W. Potter: If the sulphur in fuel oil is present as organic sulphides, we could well expect sulphur pick up in the charge during smoky melt down conditions when using high sulphur oil. Do you have any experience with using excess air or melt down to burn these sulphides to SO_2 or SO_3 and reduce metal or iron oxide absorption?

Edward E. Callinan: You are asking if the use of excess air during melt down will reduce the amount of sulfur picked up by the scrap and molten metal. I cannot answer this from personal experience, but I do recall that in the Proceedings of the National Open Hearth Conferences more than one operator has noted that an excess of air apparently has some tendency to reduce the amount of pick-up. Also, it is known that at heat treating and forging temperatures, an excess of oxygen in atmospheres containing sulfur dioxide tends to supress the formation of iron sulfides and retards this inter-crystalline penetration into the steel. Such effects vary according to steel analysis. Nickel steels, for example, are reputed to be very susceptible to such penetration. It then can be surmised that at higher temperatures such tendencies are still present and that excess air will minimize them. It should be remembered, however, that even if excess air is added to the open hearth, perfect and instantaneous mixing does not result and that a fair amount of the stock in the furnace may be wiped by products of incomplete combustion and thus be favorable to sulfur pick-up.

R. R. Fayles: When you blended these oils, what did you do on your oil preheat temperature and what did you do on volume of steam you used for atomization?

Edward E. Callinan: When on 100 per cent light oil all tracer lines and the one oil heater which served all five furnaces were cut off. This was in late spring, when outside temperatures were not low. Later when on the 50-50 mix, the heater was controlled at about 1450 F. A small amount of steam was kept in the main circulating system but the tracers on the dead end branches to each end of the furnaces were cut off entirely. This illustrates what I mentioned previously about the necessity of designing tracer lines so that they can be controlled.

Regarding the volume of steam used, I do not recall that any great change was made. Since the oil temperature was decreased so as to produce approximately the same oil viscosity at the burner, approximately the same amount of steam would be required. Mixers used were easily adjustable, and I am unable to recall at this time whether some adjustment was made in the mixers.

Pressures at the control stand (which are meaningless with respect to volume, particularly when the mixer may be adjusted) remained just about the same. The flame may have been just a little lighter, slightly less luminous appearing, but production rate was not affected.

R. R. Fayles: I can give data to the gentleman who asked a question about mixing light oil with Bunker C. We were in a position where we could not get Bunker C, and had to fall back on light oil and were plagued with the same doubts you had, about the mixing, and so forth. We went to the expense of installing air agitation in the tanks, in place of the mechanical type which was mentioned. We found out that the recirculation of the oil through the system where we are only taking about 30 per cent of what is pumped and putting 70 per cent back in the tank on the return line, gave excellent mixing of the light oil and the No. 6 oil, without any trouble whatsoever. We had a lot of fears about it, but all were unfounded. I know our open hearth people will bear me out—we operated successfully, but it was expensive—on a mixture of about half Bunker C and half light oil.

"FURNACE REBUILDING"

By W. H. SHURE

Assistant Supervisor of Maintenance

Mechanical Maintenance Department

Bethlehem Steel Co.

Sparrows Point, Md.

▲ TO satisfy the existing demands for steel, open hearths everywhere are being pushed to produce more than they ever did before. A way to accomplish this is to improve furnace availability through better rebuilding programs.

At the Sparrows Point Plant of Bethlehem Steel Co., the mechanical and open hearth departments are making a concentrated effort, with gratifying results to improve availability. In 1951 the twenty-eight furnaces operated with 95.9 per cent availability, while for the first eleven months of 1952, this figure has been increased to 96.7 per cent. The number of heats per furnace campaign has increased from 247 to 251, but, because the furnaces are making faster heats, the number of rebuilds has remained approximately the same.

The work under the classification of "Rebuilds" may be divided into three types of jobs. First, the "Quick Roof" which consists of replacing the main roof, front and back walls, patching the bulkheads and port sidewalls, removing the slag, and cleaning checkers and flues. Second, there is a "General Repair Floor Level" job, which includes replacement of the main roof, port arches, port sidewalls, and the middle block down to charging floor level. Checkers are cleaned and repaired as found necessary, the slag is removed, and necessary repairs are made to the slag pocket arches and regenerator fantails. Third, is the "General Repair Pit Level" job, which includes complete replacement of the furnace uptakes. This is usually accompanied by major regenerator work.

There are several factors to consider if these jobs are to be done in the best possible way.

PLANNING

In large steel plants where 100 or more rebuilds are undertaken during the year, it is necessary to plan all work as far ahead as is practical.

A six-month repair schedule is issued at Sparrows Point, based on an average of 250 heats per furnace campaign. This schedule is prepared by the operating department who cooperates to the fullest extent with the mechanical department in furnace repair work. Furnace conditions will change throughout the year, and it is sometimes necessary to make changes in the rebuilding sequence shown on the schedule; still it serves as an excellent guide to show the status of each furnace, and the scope of work ahead. The open hearth department holds a weekly planning and coordinating meeting attended by the open hearth supervisors and all mechanical and electrical foremen involved in the open hearth rebuilding work. In this meeting, immediate plans for the week are discussed, a rundown is given on the amount of work anticipated in the next furnace rebuild, and a general discussion is had concerning the status of the repair program. The mechanical department supervisors then proceed with the detailed planning necessary to perform the work in the best possible manner.

SCHEDULING

It is practically impossible to schedule every repair job down to the last minute. Every furnace presents new and different problems and even though furnace conditions are constantly checked, and the general scope of the work determined before hand, there is always a possibility for the brick work to be better or worse than anticipated. This is especially true when it comes to repairing regenerators. Nevertheless, it is important that the job follow a definite pattern, not only for the benefit of the foremen who have to schedule the men, but for the open hearth people who have to know when they must lend assistance. For instance, we may want to have the furnace go down for repairs at approximately 4:00 a.m. The operators know this and will make every effort to meet this time. They also know that they will have to give crane service for stripping the furnace for the first hour after the oil has been taken, and that the roof brick car will have to be placed in front of the furnace about 3:00 p.m. of the first day. The brick department and carpenter shop know that they will have to furnish men about 6 hours after the furnace comes down. A good schedule will place the peak work loads during the hours when the men can give most time to this work.

SUPERVISION

Open hearth rebuilding is certainly a major item in steel plant maintenance, therefore, it is essential to have competent supervision. Whether the work is supervised by a bricklayer foreman, maintenance engineer, or mechanical turn foreman, there must be a clear-cut line of authority established. The supervisor must see that nothing is overlooked, although the pressure

Figure 1 — Slag gun is used during demolition.

may be on to finish the job as soon as possible. Otherwise, excessive hot repairs will be needed during the subsequent furnace campaign. There may be several crafts working at the same time, and in the limited space around an open hearth furnace, confusion could easily arise unless the work is properly coordinated. Liaison work with the operating department is an extremely important phase of the supervisors work. There are times when the repair routine will have to be changed to conform with other furnace operations, but, at the same time, the furnace operators should fully understand the importance of getting a furnace back into operation and at times they too may have to make slight changes in their routine. Without the full cooperation between operators and maintenance men, uncalled-for delays are bound to occur.

Assuming that a good maintenance program has been established from the planning, scheduling, and supervision standpoint, the question arises: "How many men do we need to do the work, and how is it going to be done?", or "How fast do we want to do the job, and how much money are we willing to spend?"

MANPOWER

Having enough men to do the work is one of the keys to making fast repair times. Available manpower is the reason it is not wise to make comparisons of the furnace availabilities and rebuilding times between large and small steel plants. In a large plant that has furnaces coming down for repairs every four days, the manpower requirements are relatively constant. To take care of the peak work loads caused by unusual furnace conditions, the maintenance departments of a large plant are able to furnish more men, from other sources, in addition to the normal open hearth repair groups. On the other hand, a small plant does not have this repair frequency and their maintenance departments are relatively small. The men, most probably, must be used where they are needed the most, and possibly, the open hearth rebuilds may be temporarily stopped for more important work elsewhere.

But even in large steel plants there is an economic limit on the number of men to be assigned to open hearth rebuilds. There may be work for 70 or 80 laborers during the initial phases of furnace demolition, but an organization such as that could become unwieldy, and the resultant loss in efficiency could easily overcome any advantage gained in getting the job done a little sooner. Merely to keep up with the established repair schedules, there are times when unconventional repair methods must be employed. Despite the efforts made to cool furnaces and men, heat is always a factor with which to contend. Men working in flues and checkers 8 hours after the furnace comes off may have to be "spelled off" occasionally. To furnish relief and, at the same time keep the job moving, it therefore may be necessary to have additional men over and above the

Figure 2 — Exhaust fan with flexible tubing is used for cooling purposes.

Figure 3 — Exhaust fan is shown sucking hot air from the flues.

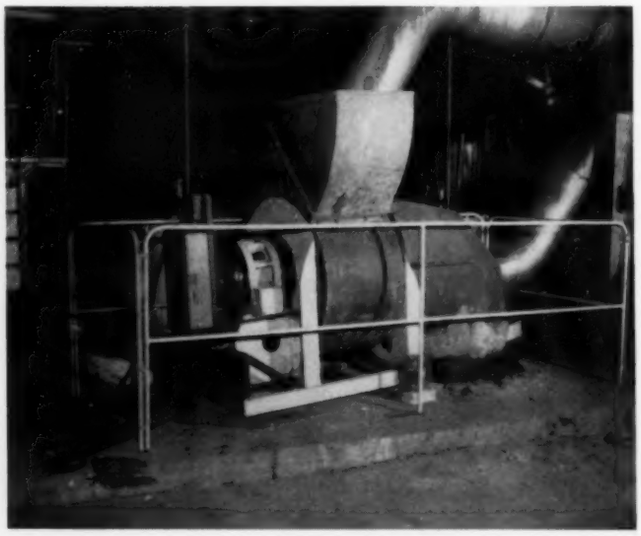


Figure 4 — End dump dirt hopper is handled by fork lift truck.

Figure 5 — Chain beaters shown are checker cleaning.

number actually required to do the job without relief. Working this way may be uneconomical from the individual job cost standpoint, but the advantages gained in keeping the job moving and staying in line with the overall repair schedule make it worthwhile. There are many mechanical aids being used to help reduce furnace repair times and manpower requirements, but there is still a wide open field for the development of machinery to take the place of time-tested manual labor.

EQUIPMENT AND METHODS

With a job of removing around 120 yards of slag and 100 tons of the flue dirt, along with removing and replacing 150,000 of 9-in. equivalent brick, material handling is a real problem in open hearth rebuilding. Pallet trucks, conveyors, and roller lines are gradually taking the place of wheelbarrows and brick tongs. Certainly proper usage of the proper type of equipment will save time as well as manpower. It is not a simple thing to mechanize a job such as this. The machinery or tools to be used must be rugged and simple to operate. The physical layout of the shop sometimes makes it an extremely complex and costly project, also it may be difficult at times to convince the repair groups that new equipment, which would change their established routine, will eventually be a benefit to them. This makes it necessary for the engineer not only to develop the use of, or design a new piece of equipment, but to follow it in work and endeavor to get an enthusiastic response from the men on the job.

For several years, we at Sparrows Point, had not made too many changes in the equipment we used and the repair methods we followed. Recently, with repairs getting more extensive, manpower more costly, open hearth services more limited, and new machinery being developed, it has been necessary to adopt new methods, both original, and those already established in other plants. We have palletized around 75 per cent of our brick and future plans include complete brick palletization. Slag, flue dirt, and brick rubble are removed by high lift tractors or dirt boxes transported on fork lift trucks. We are still trying to obtain suitable conveying

Figure 6 — A brick box used for palletized slag pocket brick.

Figure 7 — This method of conveying brick from box to slag pocket is efficient.

Figure 8 — Slag is shown in place prior to blasting.

Figure 9 — Slag is shown after blasting.

equipment for removing flue dirt and checker rubble from the furnace. The roof brick is brought to the furnace in gondolas, but plans are being made to try palletized brick on a front wall scaffold.

Slag is being blasted and removed on every rebuild. By doing this, the height of the slag is seldom, if ever, a determining factor on the length of a furnace campaign. Having low slags has enabled us to increase the area in the fantail sections by lowering the slopes, thereby providing better gas distribution and less carry-over into the checkers. To further help the condition of the first pass checkers, checkers are being replaced with 9-in. holes, flue blowers have been installed in every furnace, and a well organized checker blowing procedure is followed throughout the furnace campaign.

Our "Quick Roof" rebuild times have been improved through the use of a tight scaffold in the uptakes. This scaffold makes it possible for laborers to clean flues while the heat from the checker chamber can be baffled out through the slag pocket seals away from the bricklayers working the burner blocks, bulkheads, or main roof above. A working scaffold covers the uptakes during general repairs to provide a safety scaffold for the bricklayers working the slag pocket arches and to enable the bricklayers to install the port arches without interfering with the work in the uptakes.

Small tools that have proved beneficial to the job are air motor driven chain beaters for cleaning checkers, and slag guns for cutting front walls, slopes, and other places that require pneumatic tools for demolition. For cooling down purposes, water sprays are used in the checkers, and exhaust fans are placed on the stack flues. These exhaust fans are turned around and used as man cooling fans when work is going on in the checker flues.

There is always a preponderance of ideas for improving the job, submitted by everyone even remotely connected to open hearth rebuilds, but some of them, although helpful to one craft, are not always practical for the job as a whole. Mechanization is good up to a point, then storage facilities, maintenance and replacement costs, and setting-up times make it prohibitive. We know what has been done and can be done by using our present methods and it is wise to proceed with caution before introducing radical changes in methods and equipment.

Aside from the basic need for full cooperation and coordination during open hearth rebuilds, there are too many variables in open hearth shops throughout the

Figure 10 — A rocker shovel is cleaning the slag pocket.

Figure 11 — Rocker shovel is loading debris into truck.

country to say that one repair method is better than another. It is certainly necessary, however, to weigh the merits of all ideas accumulated from the outside or within the plant. In the interest of improving furnace availabilities, we cannot relax our search for newer and better ways in carrying out furnace rebuilds.

DISCUSSION

PRESENTED BY

R. R. FAYLES, Staff Assistant to Manager, Fabrication and By Product Steel Division, Lukens Steel Co., Coatesville, Pa.

W. H. SHURE, Assistant Supervisor of Maintenance, Mechanical Maintenance Dept., Bethlehem Steel Co., Sparrows Point, Md.

H. RUSSEL KNUST, Superintendent Mechanical Dept., Bethlehem Steel Co., Sparrows Point, Md.

JOHN LUSKY, General Foreman, Open Hearth Maintenance, Lukens Steel Co., Coatesville, Pa.

WILLIAM C. SCHULZ, Superintendent of Maintenance, Bethlehem Steel Co., Steelton, Pa.

J. GARDNER BLYTHE, Open Hearth Superintendent, John A. Roebling's Sons Corp., Trenton, N. J.

J. S. MORRIS, Supervisor of Construction, Lukens Steel Co., Coatesville, Pa.

R. R. Fayles: The author talked about economy of mass manpower on rebuilds. I wondered if he had any figures—not in dollars and cents if that is confidential—but comparisons from year to year as you have increased your furnace availability, as to what your increase in rebuild cost is per ton and repair cost per ton—if you have such data.

I would also like to ask if you make any effort to salvage refractories. On this mass repair, the opportunity for brick salvage is very limited. Of course, our friends who sell brick enjoy the fact that we throw them out on the dump, but I wonder if you make any attempt to salvage them?

Also, I would like to know what method you use for the removal of the debris taken off the checker with your "eggbeaters." In our particular shop the removal of that debris is somewhat of a problem, and I would like to know how you solve it.

W. H. Shure: In answer to Mr. Fayles' comment on the question on increased costs per ton, I cannot give you any specific figures. This uneconomic method of spelling off is not new, at all, but it is only used when we have to. The recent innovations that we have developed and are trying out are beginning to be received with enthusiasm by the men and we hope we are going to be able to bring the costs down. New equipment should eliminate a lot of "spelling off."

Brick salvage was a problem when we started blasting slag pockets in that the brick was gone before we could salvage it. Normally we load it in gondolas or trucks and send it to the salvage area where it is salvaged and returned to the open hearth. We are now going through an extensive campaign to salvage brick at the job as well as in the salvage area. Of course, there is a limited amount of salvaged brick that can be used on these furnaces. We use salvaged brick on the seals and false walls and the first five or six feet of the slag pocket false walls.

The dirt from the checkers falls into the flues or sewers under the checker chamber. It is loaded in buckets mounted on wheels, the buckets, in turn, are pulled to the manhole located beyond the checker chambers. They are then lifted up on the cellar floor with air hoists and the dirt discharged into dump hoppers, that are transported by fork lift trucks.

R. R. Fayles: Is that just running on the ground?

W. H. Shure: On the paving of the sewer.

R. R. Fayles: Is that the same as they use at Lackawanna?

Member: That is right. Our dollies and buckets are a little different, but it is the same principle.

H. Russell Knust: One point that Mr. Shure mentioned, which in my opinion cannot be stressed too much, is the excellent co-ordination and cooperaton that we have between the mechanical and the operating departments on furnace rebuilding. You must have that if you are going to do the job successfully.

When Mr. Eaton, assistant to the superintendent of the open hearth at Sparrows Point, was called on a few moments ago, he said he did not have any comments, but we could talk a lot about what he does to make our job easier in coordinating with us and in briefing us on what to expect or look for when the furnace comes off. He follows the furnaces in complete detail during their campaign and is familiar with the condition of the flue blowers, how the furnace was drafting, the condition of the checkers, the regenerator roofs, fantails, etc., and therefore is able to give us an excellent prediction on what we are going to find and what he thinks should be done when the furnace is torn down.

I just want to reiterate, that it makes a lot of difference when the open hearth operating people are on your side. This is true at Sparrows Point.

John Lusky: How long did it take to put in the fan-cooling equipment in the cellar on the rebuild?

W. H. Shure: The cooling equipment is on wheels; it is just a matter of pushing the fans into place. It takes about two hours to set up the equipment.

Member: There are two, and sometimes four fans involved.

W. H. Shure: We use four fans, one over each sewer.

Wm. C. Schultz: You mentioned cooling off and spraying the checkers. Do you put water right on the checkers?

W. H. Shure: Yes, on the checkers in the form of a fine spray, feeling that steam is going to cool these checkers much faster than just air, and it does.

Wm. C. Schultz: You also said you projected the repairs for six months. On what basis was that?

W. H. Shure: Two hundred and fifty heats for the furnace campaign.

Wm. C. Schultz: How many patches do you have in this period?

W. H. Shure: The number of patches vary, some have two, some have up to six patches.

Wm. C. Schultz: If you have the schedule of the rebuild, do you also have a schedule of time for the first patch?

W. H. Shure: No. We have a regular hot gang that handles patches more or less on a day-to-day basis; it is set up almost every day by the open hearth people. They, of course, have an idea as to when a furnace needs a patch, but there is no set figure on how many heats you are going to get before patching.

Wm. C. Schultz: Is the rebuild gang the same as the hot patch gang?

W. H. Shure: No, the rebuild gang consists of the men who do the major jobs. The hot gang includes the men who go around and do the hot work. The hot work may vary from a patch in the roof to a complete roof job.

J. Gardner Blythe: How long after the oil off do you put in the fog spray in the checker chamber?

W. H. Shure: Within an hour.

J. Gardner Blythe: Have you done anything about the dampers during that time—leaving them unblocked or reversing?

W. H. Shure: We put the furnace on center. We block open all the dampers.

J. Gardner Blythe: You do not do anything in the line of reversing at that time?

W. H. Shure: No. The oil comes off, the furnace goes on the center, and we block open the dampers.

J. S. Morris: In Mr. Shure's Figure 1 are shown two men who were using an oversize air gun, and Mr. Shure remarked that they never used the ordinary paving breakers. Why?

W. H. Shure: The slag gun is our favorite tool. When you are cutting through red hot slag, the points of a concrete breaker go bad too fast. The slag gun delivers a heavier blow, and the larger points last longer and are easier to change.

"FURNACE DESIGN AND BRICKWORK"

By H. C. Paxson

Assistant to Superintendent

Refractories and Fuel

Lukens Steel Co.

Coatesville, Pa.

▲IN the year 1858, William Siemans constructed the first experimental furnace employing the regenerative priniciple which proved that very high temperatures could be reached with a great saving of fuel. However, it was not until 1868 that he perfected his idea that steel could be made from pig iron, by oxidizing the carbon with iron ore, and in turn combined this idea with his regenerative principle to bring into being the first open hearth furnace. As is to be expected when anything new is developed, there have been many variations in the design and brickwork usages for the open hearth furnace, but the principle upon which it operates remains the same.

From the construction of the first furnace and up to the present time there has been a never ending struggle to find ways and means of combating the deleterious effects of high temperatures developed in the furnaces as they have changed in design and use of higher Btu fuels. These high temperatures cause a rapid deterioration of refractories which results in frequent repairs and decreases the availability of the furnaces for production. Therefore it is essential to first find and perfect refractories that are capable of withstanding the extreme temperatures and secondly to make certain design changes of the furnaces to give a better flow pattern of the gases, so as to reduce their wear on the refractories.

There have been many articles and books published regarding the development of refractories to give increased furnace life, also many have been written concerning design changes that have made for greater furnace availability. This paper will center its discussion around the refractories predominately in use at the present time, and those design changes that have occurred in recent years, stressing in particular their applications in the open hearth furnaces at the Lukens Steel Co. plant, in an effort to produce greater furnace availability. To simplify the discussion and to avoid repetition we will discuss the furnace by sections. To orientate each section with its proper location as to the furnace as a whole let us look at Figure 1. Here we see at A the hearth or bottom, B the frontwall, C the backwall, D the roof, E the furnace ends, F the fantails, G the slag pockets and leading from the slag pockets, the checker chambers which are not shown on this drawing.

HEARTH

In recent years the trend for furnace hearth construction has been toward the use of basic castables to form the contour of the bath, and on top of this basic brick in the form of an inverted arch. Over these is rammed a commercial bottom material varying in magnesium oxide content (MgO) from 65 to 95 per cent, the trend at the present time being toward the 95 per cent MgO material. At this point the furnace is fired to the correct temperature to properly burn in the rammed bottom. Next comes the addition of dolomite and cinder in set quantities and proper burning in to finish off the making up of the hearth to its required dimensions and contour. As previously stated, this type hearth construction is only a trend and by no means constitutes any great portion of furnaces. Every open hearth manager has his own set ideas as to how a hearth should be constructed and what materials should constitute it. Regardless of the type construction or materials used, the open hearth management in our plant feels there is a more important factor contributing to greater furnace availability, namely, the proper training of furnace crews in hearth maintenance during the campaign of the furnace. This is a program that entails a lot of time and effort on the part of supervision, but one that will show profitable results when properly administered. Thru experience with this program in our plant we have been able to reduce the bad bottom delay time from thirty three minutes per heat to twenty one minutes per heat during the last seven years without any change in bottom construction or material. The above figures do not include a fettling time between heats of

twenty five minutes. However, we are still trying to improve this practice by further training of personnel and the use of newer and supposedly better materials for bottom making.

FRONTWALL

The use of basic brick for frontwall construction has been standard practice for many years with the only controversy being over which basic brick gives the greater life, plain or plated, burned or unburned. Recently the thought has been that the plated burned brick gives slightly better life. Regardless of which type basic brick is used, it gives far greater frontwall life than was realized from the use of silica brick, and this means greater furnace availability due to less down time for hot repairs. With the use of silica brick, the average frontwall life in our shop was thirty four heats, where with basic brick, the average life is one hundred eight heats.

In the last few years, the construction of frontwalls has changed slightly with the advent of archless frames for door openings. Prior to this development the typical frontwall construction was as seen in Figure 2. Here is employed the use of the conventional sprung arch over the door opening. This type construction left much to be desired since the arch seemed to be a target for the charger operator. Although the average frontwall life was good, you frequently had to repair one arch that would fall out with a little help from the charger. By the use of archless frames we get a much sturdier structure as we can see in Figure 3, note the better tie in of the jamb and the elimination of the sprung arch. By the use of the archless frame we have been able to increase frontwall life to an average of one hundred thirty eight heats as compared to the pervious average of one hundred eight heats. In addition to increasing frontwall life, the archless frame makes for quicker hot repairs since it eliminates the necessity of removing doors and frames. In repairing the sprung arch frontwall it is necessary to use centers to form and support the arch during the repair. Due to the extreme heat the frames must be removed to allow the bricklayers to build the front.

BACKWALL

Refractory wise, the same materials have proved as satisfactory for backwall construction as they did for frontwall construction. With the use of silica brick, our backwall life averaged forty six heats and by using basic brick has increased to one hundred thirty nine heats. However a structural change to backwalls has taken place in recent years which now results in a complete run of a furnace being possible from one backwall. This change was from a straight vertical backwall to a semi-sloping backwall as seen in Figure 4 or the full sloping backwall as seen in Figure 1. A full run on a furnace is the time or number of heats elapsing between rebuilds to the furnace, in our case an average of one hundred seventy eight heats or about three and one half months. In backwall life we have reached what we ultimately hope to accomplish for all sections of the furnace, the elimination of all hot repairs during the run of the furnace.

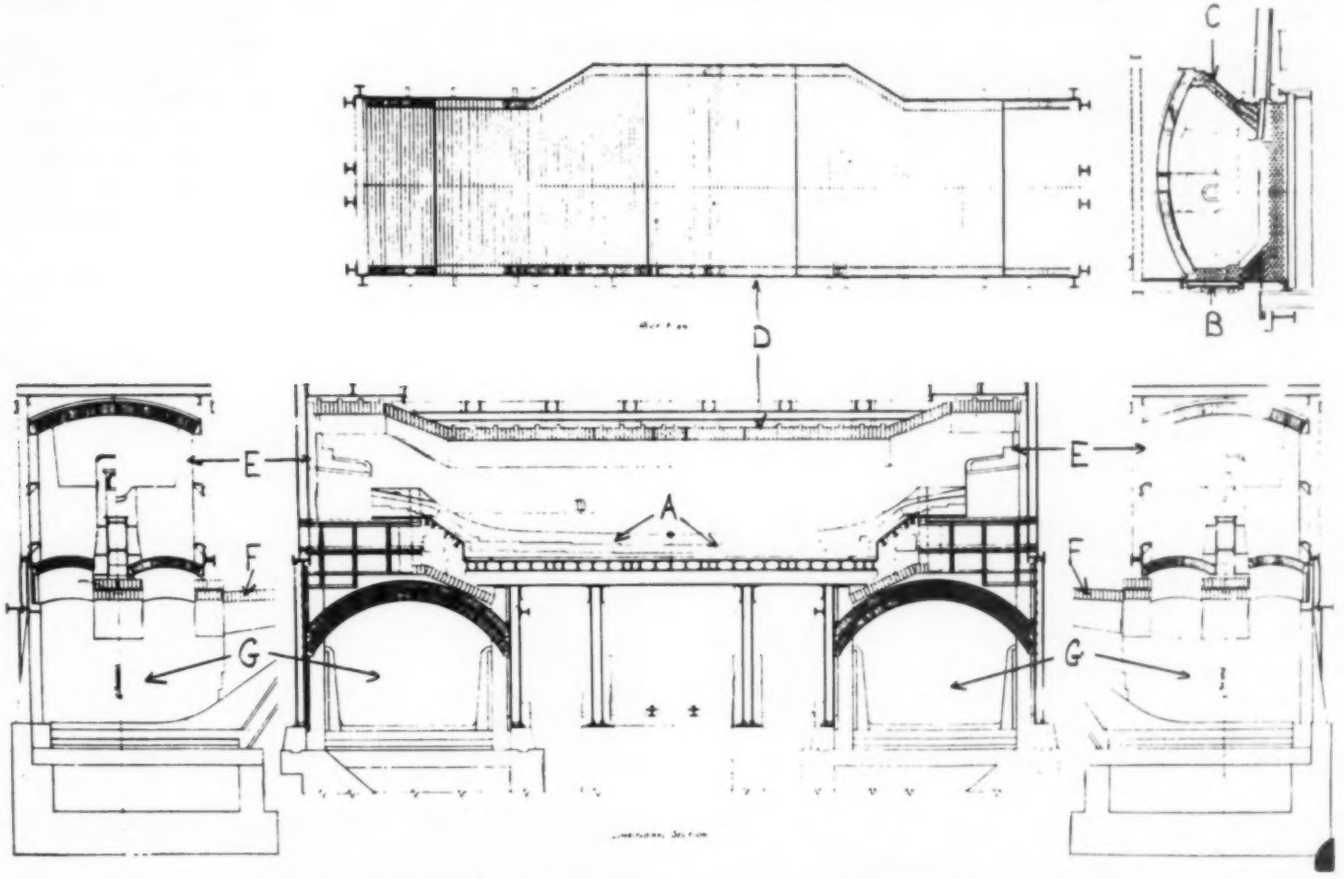


Figure 1 — Schematic shows sections of open hearth discussed in this article.

Figure 2 — Until the last few years, the typical front wall construction had arch frames for door openings.

Figure 3 — A sturdier frame is now obtained by the elimination of the sprung arch.

ROOF

This portion of the furnace, I venture to say, has been the topic of more discussions than has any other section. Particularly because the life of the furnace as a whole is more or less determined by roof life and also because of the difficulty in making hot repairs.

In the United States, up until 1944 to 1945, regular silica brick had been used for all open hearth roofs, with the possible exception of some all basic roofs as experiments. It was a known fact that silica brick would withstand higher temperatures and slag attacks better than any refractory with the exception of basic brick, and the all out use of basic brick was prohibitive due to their extreme cost per nine inch equivalent. In 1944 H. Kraner reported on a series of investigations concerning the effect of alumina in silica brick. From his investigations, he had determined that low alumina content in the silica brick raised their fusion point, and thus increased their resistance to temperature and slag attack. As a result of his report there came into being what is now called the superduty silica brick, a brick containing less than one half of one percent alumina. With the advent of this brick, nearly every open hearth operator in the country began to experiment with its use in his plant. After considerable experimentation in our plant, we found it was not economical to construct entire roofs of this type brick due to the premium price charged for it in comparison to regular silica brick. Therefore was have adopted their use in those sections of the roof where greatest wear occurs, namely, the knuckles and along the front and back skews. By going back and looking at Figure 3 and then at Figure 4 we see these areas clearly outlined.

At the present time, there is a considerable number of experimental roofs in operation employing the use of alternate courses of basic and silica brick. This type construction, at present, is being used only in those roof sections having extreme wear. We have tried this type construction, but found it is not economical in our shops due to the long roof life we are now getting from the use of regular and superduty silica brick.

FURNACE ENDS

This term includes that area of the furnace from the slag pockets to the port roof. The slag pocket walls are generally constructed of high duty clay or silica brick. The walls leading from above the arches to the port

Figure 4 — Semi-sloping back wall is illustrated in this view. This has increased furnace life.

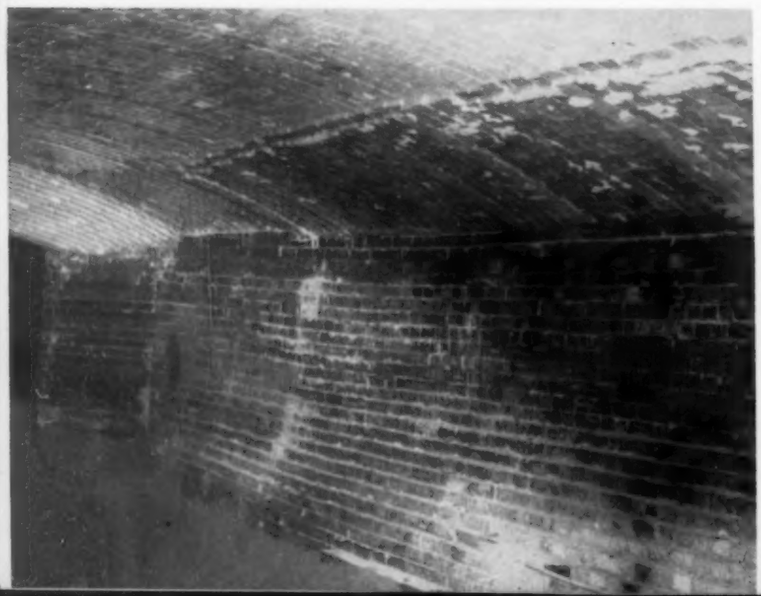


Figure 5 — Steel plate supports make basic end construction expensive in initial cost.

roof are constructed of silica brick with the exception of the end bulkheads that are basic brick. The reason for basic brick bulkheads is to reduce wear in this area due to the impingement of non-combustibles being carried in the exhaust gases. The wall thickness in end construction will vary from eighteen to twenty-seven inches depending upon the shop and their operating conditions. Regardless, however, of the shop, it is most common for a furnace end to be completely replaced after four hundred fifty heats.

The type of end construction just described comprises approximately ninety-eight per cent of the furnaces in operation today. The other two per cent are those furnaces of all basic brick construction. True, the all basic end furnace costs considerably more than the conventional silica end furnace to install, but the extended life and resultant production tends to compensate for installation costs. This fact is especially true where every available furnace hour is needed.

One thing that makes basic end construction so costly is the fact that basic brick have low hot load strength, and thus must be supported in some manner. The typical construction is by suspension from castings hung on rigid steel bindings, and steel plates laid between brick courses and anchored to buckstays. Figure 5 is a view inside the furnace showing the steel plate support.

As evidence of the long life obtained from basic ends, we have one basic end furnace that was put on the line in November of 1947 and has been in service ever since, with exception of minor repairs. To date the furnace has made over twenty-two hundred fifty heats and in all this time we have made no repairs to the chill arches, fantails and approximately one-fifth of the end walls.

FANTAILS

This section of the furnace, which joins the regenerator or checker chambers to the slag pockets, is both difficult and expensive to maintain. The difficulty arises from trying to keep the section tight to avoid air infiltration, and the expense results from excessive wear.

The majority of open hearth furnaces in operation today have the double checker chamber design, of air and gas chambers, which is a throw back to the days when producer gas was used for firing. In Figure 6 a view looking toward the checkers from the slag pocket, can be seen the fantail arches and the roofs of the checker chambers. In this view, note how small the fantail opening is in comparison to the areas of the slag pocket and the checker chambers.

In an effort to simplify construction in the fantail section, and at the same time get a better flow of incoming air and exhaust gases, many shops are going to a flat suspended arch. In most shops, this has been done with superduty clay, semi-silica or silica brick tile suspended from castings. For those furnaces of all basic brick end construction, they employ basic brick in the nose of the fantail. By the use of the suspended arch the division wall between the air and gas chamber of the checkers is eliminated. The elimination of this wall allows for greater volume and opens the throat area for a better flow of gases.

Like many other shops, we too have gone to a flat suspended arch in this section of the furnace, only instead of using refractory tile we are employing the use of a plastic fireclay refractory. Also, instead of eliminating the division wall and sprung arch construction between the checker chambers entirely, we are taking it out only to seven feet beyond the face of the slag pocket bridgewall. The reason for doing this was two-fold, first to reduce installation costs and second to determine if the change would be of benefit to operations.

To support the plastic fantail arch we installed a wide flange fourteen inch fabricated member, with gusset plates on twelve-inch centers, across the opening between the slag pocket and checker chambers. To the gusset plates are bolted three-inch I-beams which run back five feet eight inches to a fifteen-inch I-beam that spans the two chambers and is supported on the outer walls. Then leading to the next fifteen-inch I-beam are also three-inch I-beams. All of the three-inch I-beams are on twelve-inch centers and welded to both fifteen-inch I-beams. Hanging from the three-inch I-beams are the fireclay anchor brick that support the plastic. The anchor brick are also on twelve-inch centers. The silica brick wall above the wide flange member extends two inches beyond the face of the fantail nose. This is done to offer protection to the nose from the silica wash of the checker wall above it during the operation of the furnace.

Figure 6 — Fantail opening is small in this design in comparison with slag pocket and checker chamber areas.

Figure 7 — Throat area is opened up through the use of plastic firebrick suspended fantail arch construction.

Figure 8 — Refractory wear after 161 heats is shown in this view.

Figure 9 — Refractory wear after 476 heats is shown in this view.

In Figure 7, we see a plastic firebrick suspended fantail arch installation, note how the throat area has been opened up.

Usually the first question asked regarding this type construction is, how long does this refractory stand up in service and how does it compare with silica or clay brick for repair costs? The answer to the first part of this question is that the plastic fireclay is lasting one and one-half times as long as silica brick in the nose area, and gives every indication of lasting longer in the flat arch section, than does the refractory we presently use. In our practice we normally replace the face of the brick fantail arch section after 350-370 heats and the back section after 1250-1300 heats. The first furnace to come off for repairs was after one hundred sixty-one heats and in Figure 8 we see the wear to the refractories. In Figure 9 we see the same furnace fantail arch when the furnace was down for repairs after four hundred seventy-six heats. At this time it was necessary to renew the nose section only, the flat arch section is still of the original thickness. Costwise it is cheaper to renew the nose section with plastic than to replace the face of the brick fantail arch.

From the design and refractory material changes to the fantails, we have shown good results in furnace operation. Each furnace that has had this change shows a gain in tonnage of 0.70 to 0.85 tons per hour and a reduction in fuel of from five to eight per cent. The cost for making these changes is twice that of installing the conventional sprung arch structure, but the gains more than compensate for this difference.

CHECKERS

In addition to increasing checker volume in the manner just discussed, there are two other methods that have been used in recent years.

In those shops having ample room in their cellars to expand and new shops under construction, they employ the use of two-pass checkers. In this type construction, they divide the checker chamber into sections with the use of two transverse walls with space between them, and one wall open at the top and the other open at the bottom. The flow of gases through this style checker is lengthened and the velocity impeded so that more sensible heat is absorbed and radiated by the checker brick.

Most shops are handicapped for room, so must find other means of increasing checker volume. The most recent trend has been toward the use of furnace stacks with their base composing a desired make up checker volume. The stack employs an air fan and an ejector fan which makes for better furnace control in shops having too little checker volume. In a sense the stack arrangement is a two-pass checker since the primary checker chamber and the chamber in the base of the stack are separated by a flue. In some shops they have been able to more than double their checker volume with the use of these stacks.

SUMMARY

In a rapid and minor way, furnace design and brickwork changes which have occurred in recent years that would result in greater furnace availability for open hearth shops have been outlined. By no means have we more than scratched the surface in this discussion. It behooves every man in the steel plant organization to exert every effort toward increasing open hearth production, because it is here that operating costs are greatest.

DISCUSSION

PRESENTED BY

J. EUGENE DEEGAN, Ceramic Engineer, Bethlehem Steel Co., Steelton, Pa.

H. C. PAXSON, Assistant to Superintendent, Refractories and Fuel, Lukens Steel Co., Coatesville, Pa.

J. Eugene Deegan: On one illustration that Mr. Paxson showed, I noticed an arch, above the suspended nose—is that sprung from the middle arch across to the side wall? If so, what is the purpose of that arch?

H. C. Paxson: It is a thrust arch from center arch to the pit wall, and is just as the word denotes, a thrust arch. 18 in. in thickness.

By FRED C. REUTENAUER
Design Engineer
Elliott Co.
Ridgway, Pa.

AIR FILTERS IN ROTATING ELECTRICAL EQUIPMENT COOLING SYSTEMS

. . . . much additional data is needed on contaminants in air to select proper equipment for cleaning for motor rooms . . . . in addition, data on what degree of cleanliness is required to provide lowest cost operation is needed . . . .

▲ COOLING systems for electrical rotating equipment are of two types — the recirculating and non-recirculating systems. Except in the case of recirculating arrangements where the construction is sufficiently tight to insure against air leakage, both methods constantly draw cooling air from the outside. Usually the amount of make-up air is about 10 per cent of the total air for recirculating systems as against 100 per cent for the non-recirculating systems. Because of the impurities which are always present in outside air and are especially concentrated around industrial plants, it is necessary that the air be cleaned in order to protect the machinery and reduce maintenance.

It is not uncommon to find in the air around industrial plants approximately 2 grains of dust per thousand cubic feet. With this concentration of dust, a cooling system requiring 6000 cfm of air operating for ten hours would draw into the system one pound of impurities. A microscopic examination of a typical dust sample from an industrial area shows:

Smoke carbon (soot)	45	-47	per cent
Silicious material	40	-43	per cent
Coal dust	2½	- 3½	per cent
Fibrous matter	3	- 4½	per cent
Miscellaneous	6	- 8	per cent

While the composition of atmospheric dust will vary with locality and season, these values are typical and give some idea of the ratio of the constituents present. In almost every case approximately one-half the dust is soot. Soot, because it is both a conductor of electricity and a non-conductor of heat is a double menace to electrical machinery.

Accumulation of dust within electrical equipment has been the cause of many failures. Due to the conducting nature of the dust, grounding of the windings is the most frequent source of trouble. Dust can also cause sparking and excessive maintenance of collector rings and commutators. Electrical equipment requires periodic cleaning to prevent dust accumulation. The frequency of such cleaning is materially reduced through the use of filtered air for ventilation.

The choice of the proper type of air filter for any particular installation involves many variable factors including air volume, allowable pressure drop, dust concentration, degree of cleanliness needed, space available, and type of maintenance wanted. In order to give proper consideration to these various items it is first necessary to have an understanding of the principles involved in air filters, their form, and their operating characteristics.

Three principles of air cleaning are employed in the various air filters available. These principles are dry filtration, viscous impingement and electrostatic precipitation.

For dry filtration a medium having small pores is utilized and combines dust impingement with straining action. Materials such as felt, glass fibers, cellulose fibers and filter paper are used as media. Most dry type filters are available only in the unit or panel type, although there are dry type filters in which the medium is automatically changed, the action being dependent upon the pressure drop across the filter. Panels are available in the disposable, cleanable medium, and renewable medium types. Because of their comparatively low dust holding capacity, dry filters are not recommended for use in localities where the dust concentration is high. They are suitable where the dust concentration is below 1 grain per thousand cubic feet.

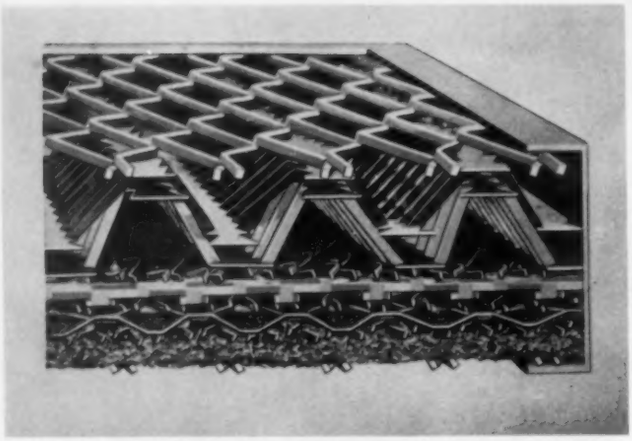


Figure 1 — Figure shows section taken through a 2-in. thick, washable viscous impingement filter.

The initial resistance across 2-in. thick filters is usually 0.1 to 0.15 in. of water operating at air velocities of 260 to 350 fpm.

The medium for the viscous impingement type filters consists of a multiplicity of adhesive coated obstructions which divide and deflect the air stream so that the dust particles may be mechanically separated and trapped in the viscous coating (Figure 1). The medium usually consists of layers of various gage wire mesh, crimped and laid one on top of the other with air flow perpendicular to the mesh or with wire mesh crimped in "herringbone" or "z" designs stacked side by side with air flow parallel to the mesh. Panel type have high dust holding capacity and operate at air velocities between 350 to 500 fpm at an initial resistance of approximately 0.1 to 0.15 in. of water for two-inch thicknesses. Most manufacturers of viscous impingement panel type filters also manufacture an automatic self-cleaning viscous impingement type in which the medium is automatically cleaned and the viscous coating renewed. Self-cleaning type filters operate at approximately 500 fpm air velocity with a pressure drop of 0.4 to 0.5 in. of water.

Panel filters in the dry and viscous type are fairly well standardized in dimensions. The sizes range from 10 × 10 to 20 × 25 in., in thicknesses of 2 and 4 in. The 2 and 4-in. thicknesses are the most common although there are filters less than 1 in. in thickness and some as thick as 9 in.

Electrical precipitation is a method of removing dust particles from the air stream by electrical attraction. It is accomplished by imposing a definite electrical charge upon the dust particles and then causing them to pass over charged metal plates of opposite polarity, to which they are attracted. This is illustrated in Figure 2. The illustration shows two grounded electrodes, a positively charged wire between them, and charged plates behind them. The space between the wire and electrode is ionized by the application of high voltage. Thus when the dust particle passes through the ionized space, it acquires a definite charge and then must pass between the charged plates and is collected on either a positive or negative plate depending on its own charge.

With such an arrangement, the efficiency of the unit depends upon the inertia of the dust particle, the electrical force tending to pull it toward the charged plates and the length of the plates. If the plates are too short or the velocity too high, the charged dust particle will pass through the filter without striking the plates. From this it can readily be seen that the efficiency of an electrostatic type filter can be increased by reducing the air volume. Air velocities of about 500 fpm give an efficiency of approximately 85 per cent, and 400 fpm gives approximately 90 per cent. The pressure drop across the filter is approximately 0.3 in. of water.

The type filter is usually mounted in cabinets of various heights and two standard widths, any number of which may be placed side by side. It is possible with this method to remove airborne solids as fine as tobacco smoke particles with an efficiency that provides the highest degree of air cleanliness ever attained commercially.

There are no generally accepted standards in the air filter industry by which the operating characteristics of the various air filters can be compared. Because of this lack of standards, the published data is too often misleading and confusing.

Several test procedures for determining air filter efficiency have been developed — count, weight, visual comparison, discoloration. None of these has been generally applied to all types of filters. The two procedures most commonly used are the American Society of Heating and Ventilating Engineers weight method and the U. S. Bureau of Standards discoloration method.

In the American Society of Heating and Ventilating Engineers test method, a known weight of synthetic dust is introduced into the air stream ahead of the filter and a sample of air drawn continuously from the down stream or clean air side of the filter is passed through a small thimble-like ceramic crucible of very fine porosity.

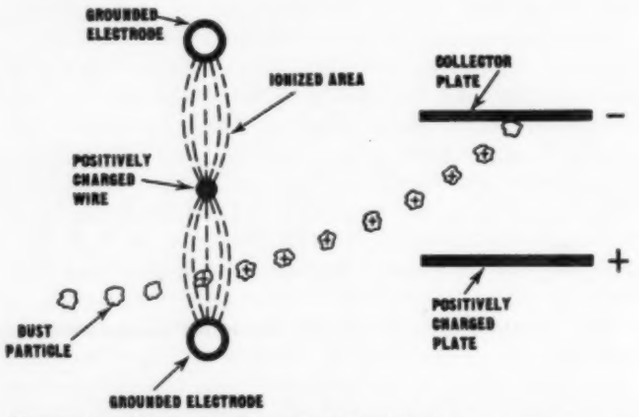


Figure 2 — Electrostatic precipitation is dependent upon applying an electrical charge to the dust particles.

The difference between the initial and final weight of the crucible represents the amount of dust removed from the given sample of air after passing through the filter. The per cent efficiency of the filter can then be easily calculated based upon the known weight of dust introduced into the air stream.

This method is practical only with a dust mixture having sufficient density to be accurately weighed in small quantities. The Standard ASHVE dust consists of 50 per cent screened Pocohantas ash and 50 per cent carbon black, which has passed through a 200 mesh screen, giving a maximum particle size of 70 microns. This ratio compares favorably with the normal distribution of solids and smoke carbons in the outside air. Since determination is made by weight, it is possible to

raise or lower the efficiency by varying the constituents of the test dust. In comparing the efficiency of competitive filters, it is necessary to know that not only the same procedure but the same dust mixtures were used in all tests.

The U. S. Bureau of Standards test method uses finer dust than the ASHVE test method. The test dust, Cottrell precipitate, consists of the material caught by a Cottrell precipitator from the stack gases of a power plant burning powdered soft coal. Particle size ranges from 0.8 to 20 microns. The efficiency is determined by drawing samples of filtered and unfiltered air through white chemical filter paper, the areas of the spots being adjusted until equal blackness is obtained. The discoloration of the "targets" is measured by a photoelectric cell unit called a densitometer to establish values from which the efficiency is computed.

Viscous filters that have an efficiency of 80 per cent or higher by the ASHVE method show an efficiency of less than 12 per cent by this test method. A dry type filter having an efficiency of 94 per cent by the ASHVE

PARTICLE WEIGHT	
0- 5 Microns	39 ± 2%
5-10 Microns	18 ± 3
10-20 Microns	16 ± 3
20-40 Microns	18 ± 3
40-80 Microns	9 ± 3
	100%

CHEMICAL ANALYSIS	
SO	68.47%
Fe O	4.58
Al O	15.98
CaO	2.91
MgO	0.77
Alkalaies	4.61
Ignition Loss	2.68
	100%

Figure 3 — Table gives the components of a standard dust for a filter efficiency test.

method has an average of 30 per cent by the discoloration method. This does not discredit air filters, either viscous or dry, for they have proven their adequacy in removing nuisance dust in many applications. It does, however, illustrate the wide variation in results obtained by the two methods.

There are variations of the above two methods in use. A "practical" dust is used by some manufacturers with either of these methods. However, unless the composition of this "practical" dust is known, the efficiency figure is of little value. For a value of efficiency to be of any value at all it is necessary that the method of determination and the dust mixture be specified.

Generally, those filters that are capable of removing the smaller dust particle, sizes (5 microns and below) are tested by the U. S. Bureau of Standards discoloration methods. Other filters are tested by the ASHVE weight method or variations thereof.

One manufacturer at present is publishing efficiency data in three forms. These are illustrated in Figures 3, 4, and 5.

These efficiencies are determined on the basis of weight with a standardized dust, using equipment developed by the manufacturer. The composition of the dust is shown both in percentage by weight of the various particle sizes and by chemical composition in Figure 3. Figure 4 shows the efficiency plotted against dust load on the filter, based on a standardized dust being fed at 20 grams per hour.

Figure 4 also shows the efficiency of the same type filter under the same conditions with the exception that the dust consists only of particles in the size range 20-40 microns. Note the increase in efficiency when the smaller dust particles are eliminated.

Figure 5 shows efficiency plotted against particle size. This curve shows that this particular filter has satisfactory efficiency down through the 5-10 micron particle size range.

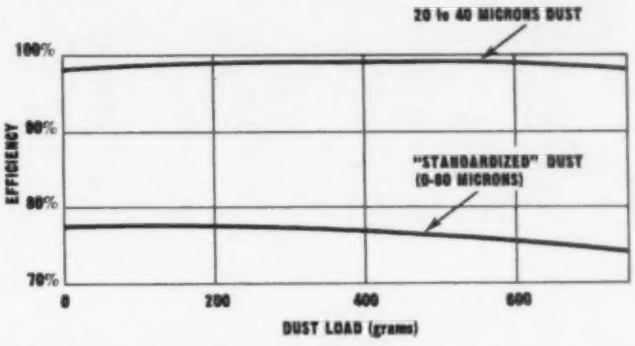


Figure 4 — The efficiency of a filter as a function of the dust load is given by this chart.

In publishing the efficiency data in this form, the manufacturer feels that "factual, full, and comprehensive data of this kind will help put the air filter industry on a firmer and sounder engineering basis." This method and form of data is claimed to be applicable to all types of filters and to show clearly the difference of performance characteristics of the various filtering principles.

There are other test methods in addition to those mentioned used by air filter manufacturers, most of them based upon weight. With performance data based on such a large variety of test methods, comparison of filters on a sound basis is difficult, if not impossible.

Resistance to air flow is another important characteristic of an air filter. Most 2-in. thick panel-type filters, operating at recommended air volume, have an initial resistance of 0.1 to 0.15 in. of water. Automatic self-

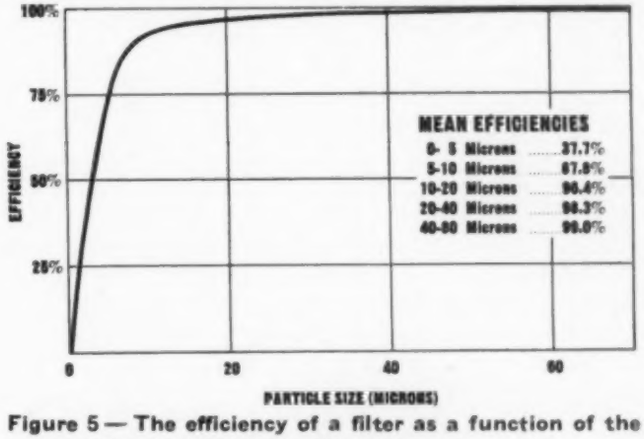


Figure 5 — The efficiency of a filter as a function of the particle size is given by this chart.

cleaning filters operate at pressure drops somewhat higher than this. Although the pressure drops are the same at recommended air volumes, the air velocities range from 260 to 500 fpm, the lower velocity applying to dry-type filters and the higher value to those viscous impingement-type filters with air flow parallel to the wire mesh medium. The advantage of the high air velocity filter can be seen immediately in the reduced face area required to handle a given volume of air. This,

of course, must be weighed against other considerations in the selection of a filter.

The actual operating resistance of filters varies due to dust concentration, air distribution, arrangement, and operating conditions which are seldom comparable in any two installations. A filter of correct capacity and properly applied should operate at a resistance closely approximating the manufacturers published data. The resistance, of course, will increase with dust load on the filter and is one means of setting up a maintenance schedule by use of draft gages. By determining the allowable resistance at which the installation should operate, either from manufacturers recommendations or from experience, the draft gages will act as an indicator to show when maintenance is necessary. If installed with a visual or audible alarm it will automatically bring to the attention of the attendant the necessity for cleaning.

The air filter resistance is ordinarily a small part of the total resistance of an installation and, although it may be 0.1 in. of water initially, it may be 0.25 in. of water or higher at the time the filter is cleaned or replaced. Sufficient power must be available in the air moving equipment to accommodate the increase in resistance. Air distribution and arrangement also affect the resistance of a filter. The published resistance data is based on uniform air distribution with flow perpendicular to the face of the filter. If the air distribution is not uniform, then a higher resistance can be expected. V-bank and staggered bank arrangements as shown in Figure 6 will also raise the resistance to air flow and must be given due consideration. Figure 7 shows increase in static pressure plotted against the angle of filter for several air velocities. The increase in resistance starts rising very sharply for angles of less than 45 degrees.

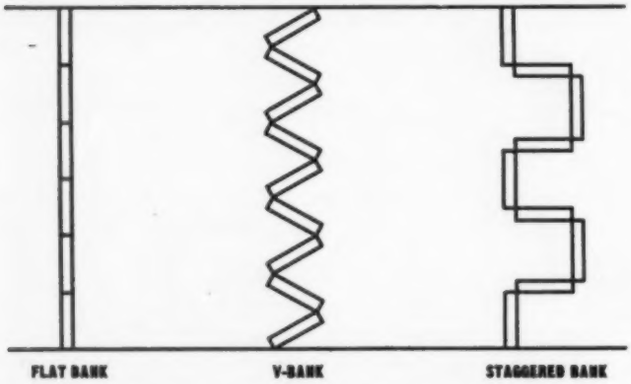


Figure 6 — Several types of filter bank arrangements are illustrated in this sketch.

All filters require some attention in order to maintain their air cleaning ability. There is always the problem of disposing of the dust collected by the filter.

Self-cleaning filters require the least attention. Periodically the sludge must be removed from the oil reservoir and the oil in the reservoir brought to the proper level. Approximately once a year the filtering screen must be inspected and should be washed down if necessary, for although these are cleaned in passing through the oil reservoir, there is a gradual build up of scum on them. Self-cleaning filters also have drive and timing mechanisms which must be periodically inspected and oiled.

If the self-cleaning filter is provided with an oil circulating system for cleaning the oil, then it is necessary to clean or replace the filter medium and also maintain the pump and motor.

Dry-type filters are arranged for reconditioning, renewing the filter medium, or replacing the entire filter.

For reconditioning, the filter medium is of such form that it can be removed to dry clean, wash, or vacuum clean and then replace in the filter frame. This method of maintenance requires auxiliary equipment and labor. Man-hours are probably higher for this method than any other.

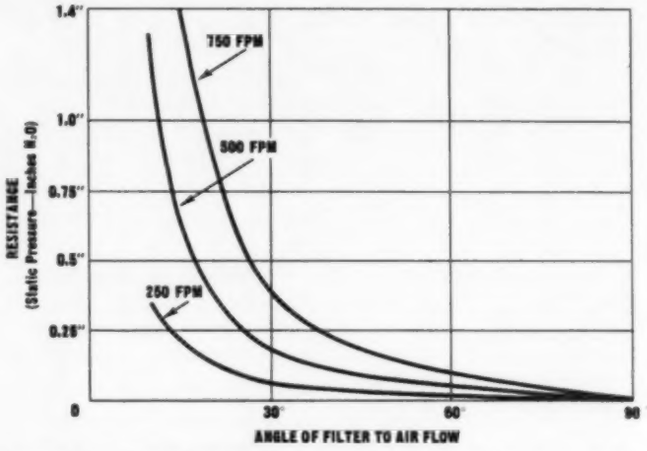


Figure 7 — The filter angle has an important effect on the resistance to air flow.

Renewing the medium costs less than other methods providing some inexpensive medium is used. For some filters it is necessary to have auxiliary equipment to fold or do other work on the medium before it is placed in the frame.

Replacing the entire filter is the most expensive type of maintenance. However, for small installations the first cost is low, auxiliary equipment is eliminated, and labor time is low.

Panel viscous impingement-type filters require auxiliary equipment and service connections for proper maintenance. It is necessary to have space where the units can be cleaned either in tanks or with water and compressed air. Dipping tanks for renewing the viscous coating are also necessary. An in-place cleaning installation where the filters are hosed clean and re-oiled in place is illustrated in Figure 8. Most filter manufacturers, however, recommend immersion for applying the adhesive. This is especially true of 4 in. thick filters where it is difficult to obtain complete penetration of the adhesive by spraying. Both self-cleaning filters and panels used for in-place cleaning installations require a periodic thorough cleaning.

The application of air filters to cooling systems for electrical rotating equipment is not much different from other air filter installations. It is necessary to consider those same factors applicable to ventilating installations in general. The actual effectiveness of any air filter installation depends not only upon the filter itself, but also upon the arrangement and associated equipment. Maximum effectiveness can be obtained only by careful consideration of other important factors in the design of an air filter installation in addition to the proper choice of filter.

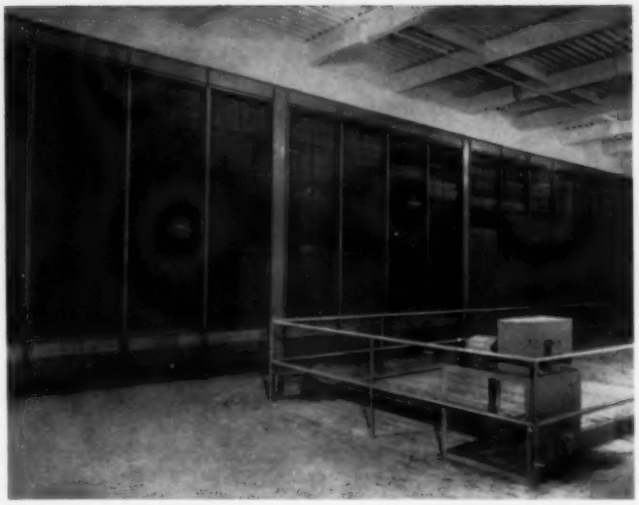


Figure 8 — Installation shown is of the automatic self-cleaning type.

Not all of the many factors involved in selecting the proper type of filter are applicable to any one installation. Each installation is unique and probably has one or two definite requirements which will determine the choice of filter.

The selection of panel or self-cleaning type may depend upon air volume. In general, where the air volume is large, a self-cleaning filter should be considered, since for large volumes the initial cost is little more than manually serviced types and the maintenance is reduced. Panel-type filters are better adapted to medium and small installations although there are installations handling in excess of 100,000 cfm satisfactorily. Since the volume determines the total filter face area needed, it may be necessary to consider space available with air volume to arrive at the best type of filter to both handle the air volume and meet the space requirements.

Panel filters are most flexible, where space is limited, and can be arranged to obtain fairly uniform air distribution in other arrangements than the flat bank. Unusual arrangements are to be avoided, and where it is necessary for the air to make sharp turns either before or after the filter, suitable guides should be provided to direct the air. Next to the flat bank, the V-bank is to be preferred. The angle of the V should not be so sharp that it will raise the resistance or disturb the air flow excessively.

Self-cleaning filters are at a disadvantage where headroom is very low, since some of the available space must be taken up with the oil reservoir at the bottom and the hood over the top. Where installations are more than approximately 7 ft high, the top filters in a panel arrangement may easily be neglected because they are not readily accessible. Self-cleaning filters are advantageous in such installations. These filters are available in standard heights up to 13 ft, but may be higher when dust concentration and operating conditions will permit.

For a given air volume, panel arrangements require less space than automatic self-cleaning filters. The self-cleaning filter requires considerably more space in depth than do the panel arrangements. Free space in front of and behind the filters is a necessity for proper maintenance and inspection.

Where the operation is continuous or approaches continuity, automatic filters are preferable (Figure 9). In those installations where it is necessary to maintain an almost constant operating resistance, the automatic filter is also desirable. Panel filters will be just as satisfactory as self-cleaning filters for normal operation of about 10 hours a day, provided a definite maintenance schedule is set up. The operating resistance of a panel installation can be maintained fairly constant by a rotation method of servicing in which a few of the filters are cleaned at frequent intervals.

Where dust concentration is high, the viscous impingement-type filter is recommended, because of its greater dust-holding capacity. The use of dry-type filters in applications with high dust concentrations increases the frequency of replacement and makes the cost of maintenance excessive.

Air filter capacity is usually chosen to be in excess of the predicted requirements, particularly if there is any question about the actual volume of air to eventually be delivered. Air filters furnished by electrical manufacturers along with rotating equipment are usually applied at 80 per cent of the manufacturer's rating. The

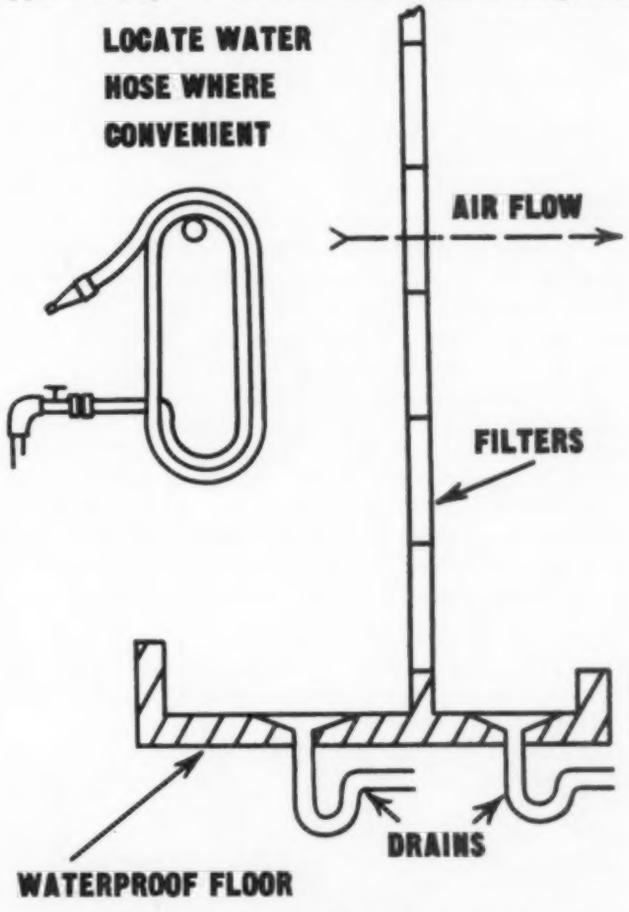


Figure 9 — Automatic filters are preferable where operations are continuous.

operating characteristics are not materially affected by underloading, but overloading not only increases the resistance to air flow, but adversely affects the dust arresting properties of the filter. This is especially true of the electrostatic precipitation type filter.

Air filters will operate equally well whether placed ahead of or behind the fan. The most common location is ahead of the fan because of the simpler duct connections, the decrease in static pressure loss due to the

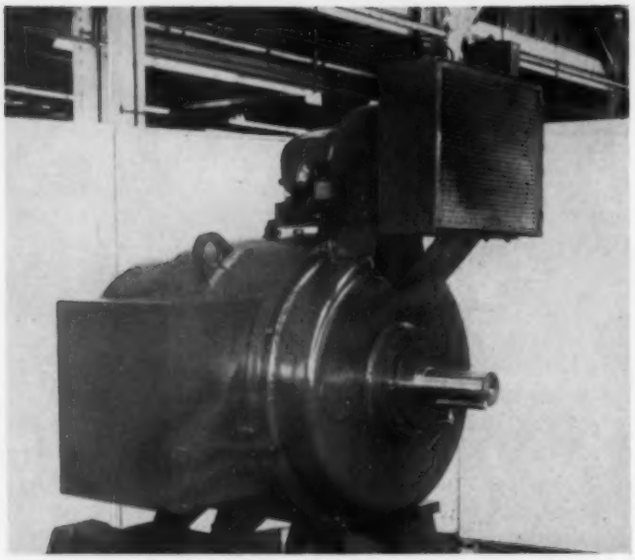


Figure 10 — This direct-current, adjustable speed motor is equipped with a top mounted blower unit and washable viscous impingement type filter.

elimination of the velocity change from fan to filter to duct, and the assurance of obtaining a more uniform air distribution. When located in this position, the arrangement should approach a square. Exceedingly high and narrow or wide and low arrangements place some filters so far from the fan inlet that they are lightly loaded, while other filters closer to the inlet are overloaded. The duct connection from filter to fan must be well sealed to eliminate leakage of outside unfiltered air into the system. If any amount of air leaks into the system, the value of the filters is largely reduced.

Air velocities at fan inlet, outlet, and in ducts are several times the values recommended for filters. This necessitates large changes of duct area which should be made as gradual as possible leading to and from the filter. The minimum angle recommended for duct work sloping toward the filter is 60 degrees between filter face and duct side. Smaller angles than this tend to cause uneven air distribution and dead air spaces.

Figure 11 — A washable viscous impingement type filter is mounted on one side of the stator for a squirrel-cage induction motor.

The cooling system intake should be located so as not to impose an excessive dust load on the filter. It should be above the heavy concentrations of dirt normally associated with ground and roof surfaces. Due consideration should be given to dust and smoke generated in the neighborhood, and the intake located to be the least contaminated from these sources.

The intake should also be adequately protected from the weather. Electrostatic filters must be protected from rain, snow, or heavy fog, since the high electrical potentials used in the ionizer and collector plates make it necessary to prevent free moisture from reaching the filter. A drop of water on the collector plates will cause arcing between the plates with consequent overloading of the power supply. Viscous impingement filters must be located with respect to the intake so that in cold weather the adhesive is maintained within its effective temperature range.

Some electrical equipment, because of its function or location in a plant, cannot be ventilated from a cooling system. Such equipment can be provided with individual filter arrangements integrally mounted. A direct current motor with top-mounted blower and filter is shown in Figure 10. Figure 11 shows an induction motor with a flat bank of filters mounted in one side of the motor frame. Viscous impingement or dry-type panel filters are used, depending upon the dust concentration encountered.

The discrepancy between published air filter performance data and actual performance in the field is generally recognized in the air filter industry. The lack of accepted standard test procedures, either comparative or quantitative, has prevented the interested filter user from being able to make an engineering analysis of the claims for the various air filters. No doubt, most of the air filters on the market today do an adequate job of air cleaning if applied in accordance with the manufacturer's recommendations and if the factors peculiar to each installation are properly considered.

DISCUSSION

PRESENTED BY

S. L. JAMESON, Electrical Engineer, General Electric Co., Schenectady, N. Y.

A. H. ARBOGAST, Combustion Engineer, Bethlehem Steel Co., Bethlehem, Pa.

R. R. THOMAS, Chief Engineer, Tennessee Coal and Iron Div., United States Steel Corp., Fairfield, Ala.

R. J. BEESWY, Superintendent Electrical Dept., Inland Steel Co., East Chicago, Ind.

S. T. MENTZEL, Electrical Engineer, United States Steel Corp., Gary, Ind.

C. B. HUSTON, Commercial Engineer, General Electric Co., Schenectady, N. Y.

FRANK CRAMER, Consulting Engineer, Elliott Co., Pittsburgh, Pa.

FRED C. REUTENAUER, Elliott Co., Pittsburgh, Pa.

S. L. Jameson: Mr. Reutenauer suggests the use of a draft gage to indicate when filter maintenance is required. We heartily agree with this recommendation.

A similar gage can be used with the oil cleaning system frequently used for self-cleaning type filters. In either case, the gage may be provided with electrical contacts to sound an alarm if the resistance to air or oil flow becomes too high due to dirt accumulation. Maintenance cannot be too heavily stressed since the operation of any system is no better than the maintenance it receives.

In nonrecirculating systems, we recommend that the volume of air brought into the machine room be 10 per cent above the actual air requirements for machines in order to maintain a positive pressure in the room.

Curves similar to that shown in Figure 5 for panel type filters would be extremely interesting for the traveling screen type of viscous filters and for electrostatic filters. Such curves should be of considerable help in selecting the proper filter to fit local conditions.

There has been considerable interest recently in the application of auxiliary filters in recirculating systems for electrical machines to remove the brush dust. The dust consists of carbon with a small percentage of copper dust and is of a conducting nature, especially when damp. It is, therefore, highly desirable to remove such dust from the system. This problem is aggravated to a considerable extent by the relatively fine nature of the dust, plus the fact that the systems which have the greatest need for filters are those systems in which there is the least space to install the filters. In a large system, where air velocities drop to 200 fpm or less, much of the carbon dust may be expected to settle to the floor and can therefore be swept out. In a small system where air velocities remain high, there may be very little settlement of carbon dust, with the result that the dust is carried back into the machine and deposited into the windings. This deposit interferes with machine ventilation and increases the possibilities of short circuits.

Brush dust concentration in the recirculated air is relatively low, and either the dry or viscous type of panel filter may therefore be used. These filters have the further advantage of requiring less space than the self-cleaning type filters.

Space limitations often require filter operation at air flows considerably above manufacturers' recommended ratings, with a corresponding decrease in efficiency. Special panel type filters for operation up to 1000 fpm face velocity, or approximately two and one-half times normal, have been used in some motors. These have only been partially satisfactory, and there is evidence that much of the finer dust passes through the filter.

Auxiliary filters for carbon dust removal are often desirable, but space limitations prevent efficient dust removal in the congested systems most needing it with filters now available.

Member: I just want to comment on that portion of Mr. Reutenauer's paper pertaining to the selection of the size of an air filter for a given job or given air volume. In steel mills and other locations of heavy industry, dust concentrations are usually quite high. We cannot overemphasize the importance of selecting an air filter having capacity 20 - 25 per cent greater than the manufacturers' maximum rating for the specific air volume. This is especially true, of course, if the duty cycle is continuous or almost continuous and, of course, it is in most steel mill services. There are many air filter installations that are a failure or, at least unsatisfactory simply because they are handling more air and dust than they are capable of.

Mr. Reutenauer has mentioned there is considerable confusion in manufacturers data due to the many types of air filters and the several methods of tests for each. That is certainly true.

There exists in the AISE a committee for the study of air filter requirements in the steel industry and to establish standards for the selection, rating and testing of air filters. It is hoped the work of this committee will result in standards and recommendations that will be very helpful in selecting air filter equipment best suited to the needs of the steel industry.

A. H. Arbogast: Mr. Reutenauer has given us an excellent description of the available air cleaning systems and their application to cooling air supplies for electrical rotating equipment.

The careful study of a paper covering this field of engineering always projects or implies various questions in the mind of the reader, some of which may be controversial.

For instance, it is sometimes necessary that auxiliary collectors be installed in conjunction with electrostatic precipitators. Auxiliary collectors would usually be applied before or ahead of the electrostatic system. However, we have had instances where auxiliary collection was applied successfully after electrostatic precipitation.

We have found that air filters usually require excessive maintenance except when installed in a closed or recirculating system. It is not uncommon to find air cleaning systems which must be washed down and completely serviced in four to six weeks instead of once yearly, as stated in this paper. This excessive maintenance requirement is probably the result of under estimation in the initial requirement specification.

The testing methods developed and used by the ASHVE and the U. S. Bureau of Standards for the determination of dust filtration efficiencies, as described in this paper, are based on the use of prepared or standard dusts and are satisfactory for this speciffic purpose.

The efficiency of filters or other dust collectors, however, will vary when applied to natural or industrial dust and air mixtures. This change in function is caused by wide variations in the chemical analyses and the gravimetric and dimensional characteristics of industrial dust and air mixtures.

The chemical analysis provides a workable index to various physical characteristics such as adhesion, abrasion, insulating properties and electrical conductivity, which the gravimetric and dimensional characteristics provide the index to filtration or collection capacity and efficiency.

It is, therefore, evident that in order to install air cleaning equipment for predictable satisfactory operation, these characteristics of the dust to be collected be known. In order to obtain these data a precise survey must be made over as long a period of time as is necessary to supply data which can be accepted as representative of prevailing conditions.

The author of the paper under discussion states that, "It is not uncommon to find air around industrial plants with approximately two grains of dust per thousand cubic feet." This is not a figure that can be accepted as a basis for the design of an air cleaning system with any more confidence than can be put in any other assumptions of dust content.

It is also of prime importance that we know to what degree the air must be cleaned in order to justify the installation economically and at the same time provide satisfactory operating and maintenance performance of the rotating equipment.

It is impossible to answer the question, "how clean is clean" in respect to air in a room housing electrical rotating equipment unless we have chemical, physical and gravimetric data from a similar installation to compare against its operating and maintenance performance.

The choice of any particular mechanical system of air cleaning is the individual design or operating engineer's privilege. The manufacturers with the assistance of the ASHVE and the U. S. Bureau of Standards have standardized on methods of determining basic filter efficiencies. It is, therefore, the responsibility of industry to standardize on methods for determining the conditions this equipment must meet. We will then be able to eliminate the difficulties and expense of either over or under estimation of air cleaning facility requirements.

R. R. Thomas: The T.C.&I. Division has had experience with the various types of filters mentioned by Mr. Reutenauer and, in addition, have used the capillary air washer which does a dual job of cleaning and cooling.

A summary of our experiences is somewhat as follows:

The dry type "throw away" filter is low in first cost, slightly higher in maintenance and is generally satisfactory for average applications.

The viscous impingement type filter with automatic cleaning has been satisfactory, but must be serviced at scheduled intervals. The removal of sludge from the bottom of the filter is a messy and difficult job but can be alleviated by the use of external tanks where the dust laden oil may be circulated to alternate tanks to allow the sludge to settle.

The electrostatic precipitation method has been satisfactory in some cases, not so good in others. They have not been satisfactory where the atmosphere is extremely dusty. None of the automatic washers of the various manufacturers has been satisfactory, and it has usually been necessary to resort to manual cleaning of the filter elements.

Considerable outage time of the automatic type units is experienced for making repairs and adjustments, the ionizer wires being the chief offender.

Mr. Reutenauer has stated the many variable factors to be considered in the selection of the type of filter. In addition to those enumerated might be added: fire hazard, corrosive atmosphere and humidity of the air.

R. H. Beeswy: Air filters and their care are extremely important in any steel mill preventive maintenance program since the majority of our motor room equipment failures can be traced to dirt.

At Inland we had an interesting experience in one of the departments, where the intake of the fan for motor room cooling was adjacent to an annealing building. Due to the sulphur in the dust that settled on the electrical equipment, sulphuric acid was formed when diluted by condensation moisture. This resulted in serious grounds and low megger readings.

I would be interested in Mr. Reutenauer discussing the types of oil used with the revolving screen filters and also the cost per gallon. We would like to obtain any information relative to a self-cleaning filter which would be entirely automatic since our maintenance people are very reluctant about accepting filter cleaning assignments.

We doubt if the electrical manufacturer is as familiar as he should be with steel mill conditions when he furnishes a filter at 80 per cent of the manufacturer's rating as we believe some conditions will require a considerably lower rating. Nothing is more detrimental to maintenance morale than to have a filter partially blocked allowing oil to be carried over onto the floor and equipment.

We agree with Mr. Reutenauer's statement that, "The actual effectiveness of any air filter installation depends not only upon the filter itself but also upon the arrangement and associated equipment," but wish to add that a good systematic maintenance program should be included.

S. T. Mentzel: In addition to the many motor maintenance problems mentioned by Mr. Reutenauer that are caused by dirty ventilation, there is the problem of plugged motor ventilation passages. Motors in heavy industry, such as the steel industry, must be frequently blown with high-pressure air to clear the cooling passages of dirt that has settled out of the cooling air and restricting the flow of the cooling medium. The higher operating temperature that results from this restriction reduces the insulation life of the motor. Filtered ventilating air, of course, reduces this problem very materially.

Mr. Reutenauer mentioned several times that the pressure drop of panel-type viscous impingement filters is 0.1 to 0.15 in. of water, whereas the pressure drop of self-cleaning viscous impingement-type filters is 0.4 to 0.5 in. of water.

I wonder if Mr. Reutenauer would please explain why there is such a large difference in pressure drop between these two types of filters?

I would also like to ask Mr. Reutenauer how the first cost of self-cleaning electrostatic filters compare with those of self-cleaning viscous impingement filters, and to what extent are self-cleaning electrostatic filters being applied as compared to self-cleaning viscous impingement filters.

C. B. Huston: When we talk about filters, invariably we discuss the efficiency of the collection of the dirt. That, of course, is of prime importance, but we must not forget that after the dirt has been collected, some means must be provided by which it can be disposed of conveniently, and here is where so many designs of filter installations may be lacking.

All of the steel companies, I am sure, when installing their equipment initially have the best of intentions to do a good job in housekeeping; but, nevertheless, fall by the wayside, and sooner or later the best of the installations may not be up to the standard for which they were initially intended. This can be attributed to a large extent to the lack of ease and means of disposing of the dirt.

I think that all of the companies manufacturing filters, all of the steel companies using this type of equipment, as well as all of the engineers who may have anything to do with recommending the ventilating system and choosing the filters should carefully consider how the dirt is to be disposed of.

I therefore throw out a challenge to all concerned to pay greater attention to means of increasing the efficiency of dirt removal.

Member: We have two turbo-blowers, on whose suction there are continuous impingement type air filters located about 75 ft up in the air, and there has never been the slightest erosion on their rotors. We also have four turbo-blowers on whose suction there is a battery of frame type impingement filters. They were carefully maintained, checked for pressure drops regularly, draft gages, and yet there was serious erosion on the rotors. The suction of those filters was at ground level.

All we did was to run a large duct up about 30 ft in the air, and all the erosion ceased. I think that one of the most important items to consider in the installation of air filters is where you put the suction.

Frank W. Cramer: The problem of selecting the proper size and type of air filters for application on motor and generator installations was discussed many times during the years I served as Chairman of the AISE Standardization Committee. For some reason it was difficult to get data regarding the dust content of the air in typical steel mill locations, which data is needed to compute the dust load on the filters.

The usual procedure in determining the size of filters is to compute the total electrical losses of the equipment, then multiply these kw losses by a factor of 100 or 120 cfm and the result is the size of filter in cfm to be purchased. Filters specified on this basis sometimes have an incoming air stream which is cleaner than the outgoing air stream of filters located where the dust load is heavy. The ultimate customer uses relative terms, such as clean, good, dirty, etc., to describe filter locations, which are meaningless, since the basis of comparison is not given.

On some installations, the filters have been a failure due to rapid clogging from the dirt.

One of these is the skip hoist houses on blast furnaces. The first installation of this type with which I was familiar, clogged up within a day. The next installation used double this capacity of filters, which was not enough and the third installation was doubled again and worked. Hence, eight times the cleaning required capacity, based on sufficient cooling air, was needed to handle the dirt load at this location.

Another recent installation in one of these so called "clean" places clogged up within a week. Here it was necessary to install a primary cleaning system ahead of the filters to get satisfactory performance.

When cleaning equipment is ordered for blast furnace or coke plant gas, a complete analysis of the dirty gas is given in the specifications and then the degree of cleaning required. This latter is based on the ultimate use of the gas and is different, if it is used in gas engines, boilers, or heating furnaces.

In the electrical applications, we not only do not know what we are trying to clean, but also how clean the air should be to give satisfactory operation of the equipment.

Mr. Arbogast of Bethlehem has been interested in this problem as a member of the Standardization Committee and may be able to contribute some information on this subject.

When we compiled the data in the AISE standards for overhead traveling cranes, the information indicated we should have five classes of cranes wherein each class would be designed for the service performed. It may be that a similar classification should be determined for filter applications based on average dirt content of the air in various locations. Each of these classifications would have a factor to apply to the filter size based on the dirt load to be handled, and the cleanliness desired. Based on this data, the application engineer could specify filters not only having capacity for satisfactory cooling air, but also capacity for dirt and dust removal.

Filter installations cost a lot of money and information should be available to insure satisfactory operation.

F. C. Reutenauer: We have a question about the air drop of the panel-type viscous impingement filter and the self-cleaning type. The panel-type I was speaking of is two inches thick. In the self-cleaning type filter there may be three or four thicknesses of filtering medium through which the air must pass. This then makes the air drop about three or four times higher.

There is a demand for copies of the following Yearly Proceedings:

1919 **1937** **1941**
1942 **1943** **1944**
1948

If your copies are not in use please get in touch with us.

ASSOCIATION OF IRON AND STEEL ENGINEERS, 1010 EMPIRE BLDG., PITTSBURGH 22, PA.

FLYING SHEARS FOR BILLET, BAR AND ROD MILLS

By J. H. HITCHCOCK
Director of Research
and
E. S. MURRAH
Electrical Engineer
Morgan Construction Co.
Worcester, Mass.

. . . the flying shear is one of the many ingenious engineering developments necessary for the successful operation of continuous production units . . .

▲ INTRODUCTION to this subject properly begins in the year 1869, when the Washburn & Moen Manufacturing Co. of Worcester installed the first continuous mill in the United States. This mill was built by Bedson of Manchester, England, and was ordered at the instigation of Charles Hill Morgan, then superintendent of Washburn and Moen Co. Mr. Morgan had seen the original Bedson mill in England, and was convinced of the advantages inherent in continuous rolling. He was a middle-aged engineer who had prepared himself for his career by serving as a machinist's apprentice. He was also a man of broad vision and conviction; it was he who founded our company in 1891 after building for Washburn and Moen a continuous rod mill employing all horizontal stands and using twist guides for the first time. This mill, as a matter of interest, remained in operation in the Worcester plant of American Steel and Wire Co. until 1927.

This brief historical statement[1]* is introduced because the development of the continuous mill necessitated the development of the flying shear. In 1888 a continuous mill to roll rods was designed and built for the American Wire Co. of Cleveland, which later became a part of American Steel & Wire Co. This initial mill was exhibited in 1892 to officials of Jones & Laughlin, who inquired whether the continuous rolling principle could be applied to the rolling of billets. They stated: "It would obviously be a development which would give to steel plants a machine so efficient and so saving of hard labor under fierce heat conditions as to be not only a mechanical contribution to the art of rolling, but it would also rise much higher to the plane of the humane."[2] Their suggestion was followed, with the result that C. H. Morgan returned from Pittsburgh with contracts totalling $20,000 for the engineering and complete detail drawings of three entirely new mills.

One of these was to be a billet mill, designed to receive a 4 x 5-in. bloom, 90 ft long direct from a blooming mill and roll it into 1½ in. square billets. The product from one bloom would have been 800 ft long, but the total length available on the site for rolling and disposing of the product was limited by a railroad embankment to 150 ft. Obviously, the installation of a continuous billet mill required a practical means of dividing the rolled billet into suitable lengths as it emerged from the finishing stand. Confirming again the adage that "necessity is the mother of invention," Victor E. Edwards, then chief engineer, invented and built the first flying shear (Figure 1) which was operated by a steam-hydraulic intensifier. Except for numerous refinements subsequently developed, this was exactly like the steam flying shears which are in use today. At that time it was a new and revolutionary device, subject to violent skepticism. The customer's mill superintendent, among others, considered the whole project preposterous and predicted that even if the mill did work, the shear would be a complete failure. In derision the machine was called a "flying shear;" this was the origin of the term which is used so commonly today to designate any

*Numbers refer to Bibliography at end of paper.

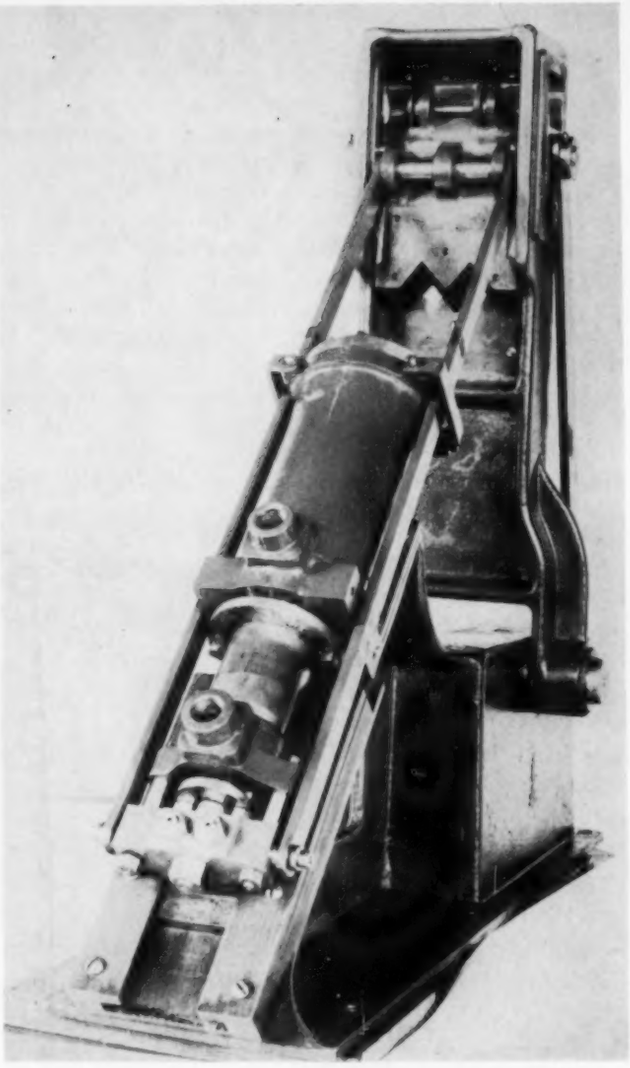


Figure 1 — The first flying shear was built in 1893.

shear which cuts metal while in motion. Fortunately both the billet mill and the flying shear operated perfectly, even though each was the first of its kind.

As in many more recent installations, this shear was tripped mechanically by a movable flag located in the path of the billet. The distance from the shear to the flag determined the length of cut. According to available records, this was the first flying shear in the steel industry, and also the first continuous billet mill installation. Figure 2 is an installation view of this mill. The flying shear may be seen behind the cobble. It is interesting to note that even in those days they made cobbles occasionally. This particular cobble was not attributed to the shear, but to the breakage of a cast iron coupling spindle.

Figure 3 is a photograph of a more modern flying shear wholly operated by steam. The design has changed with time but the principle is the same. Compressed air has been used instead of steam on some later installations.

In 1897, we built a rod mill for the Joliet Works of Illinois Steel Co. The mill consisted of a group of roughing stands and a group of finishing stands with a steam flying shear between the two groups. As in modern practice, this shear was used to crop cold front ends, in order to prevent split ends from causing cobbles in the finishing mill. Because this was a double strand mill, the bottom knife of the shear was made wide enough to bridge all strand lines. The hinged upper knife was made narrow to cover only one pass line, and was mounted slidably so that it could be moved into position and used to sever either strand without shearing the adjoining bar. If a cobble occurred in the finishing stands while the billet was still passing through the shear, the operator would trip the shear and then grab the sheared front end of the remaining length of bar with tongs to direct it onto the mill floor. This, we believe, was the first crop and cobble shear.

These early mills were driven by steam engines, so that it was natural to power the flying shear with steam. In succeeding years, steam gave way to electricity for both main and auxiliary drives, but the flying shear defied electrification, and so continued to dominate its field for more than half a century. One of the principal reasons for this can be illustrated by a simple example. If billets delivered at 750 fpm are to be divided into 20-ft lengths, the shear must start and stop 37 times per minute, and in each cycle the shear must be accelerated from rest to billet speed, make a cut, retard and return to its original preset position, all in 1.6 seconds.

The shear parts, in order to have sufficient strength, must necessarily possess substantial inertia. To accelerate this mass and bring it to rest again in the short time available, even ignoring the power for shearing, requires a large expenditure of power over a short period of time. A driving motor, required to develop this power even momentarily, must have a very large continuous capacity. Such a motor or motors, even of modern design, have appreciable inertia of their own. This in turn increases the required motor rating still further. If more motors are added to get increased torque, we find that the problem becomes one of "lifting oneself by the bootstraps."

Another approach might be to employ a flywheel to store up energy. The motor with its flywheel would run continuously and the shear proper would be started and stopped for each cut by means of a clutch. With the high speeds and inertia involved, such clutch opera-

Figure 2 — The first continuous billet mill was built in 1893. Cobbles were not new at that time.

Figure 3 — A modern steam flying shear. Compressed air has been used in some cases.

tion would be highly impracticable. Many other alternatives also have been considered.[3]

An electrically driven flying shear for round or square sections, to be successful, must meet a number of requirements which are not encountered in other shearing operations, and which together present one of the most difficult design problems in rolling mill engineering. Although the area of a square or round section may be comparable to that of a thin wide strip, the depth of the section brings with it a number of considerations which can be ignored in the shearing of thin strip. In shearing billets, for example, the extended duration of the cut requires the shear knives to travel a considerable distance forward with the billet during the cut. For this reason, the forward speed of the shear knives must match the billet speed quite closely, in contrast to the shearing of strip which permits a very considerable disparity in speed between the knives and the material. The force required to shear a billet is large, and because the action of the shearing force extends through a much greater depth and over a much longer period of time than in shearing strip, the requirement of energy for each cut likewise is very much greater. In addition to these requirements which are peculiar to billets, the successful billet shear must also be capable of handling products in whatever range of size is included in the rolling program, each product at its appropriate delivery speed, and must be adapted to shear the product into uniform lengths.

A great deal of thought and effort has been devoted to the development of an electrically driven flying shear for billets which would meet all of these requirements adequately. One such study in which one of the authors collaborated was made 20 years ago. Not all of the problems were amendable to satisfactory solution at that time; this was equally true of a good many subsequent efforts. In fact, it was not until 1945 that prin-

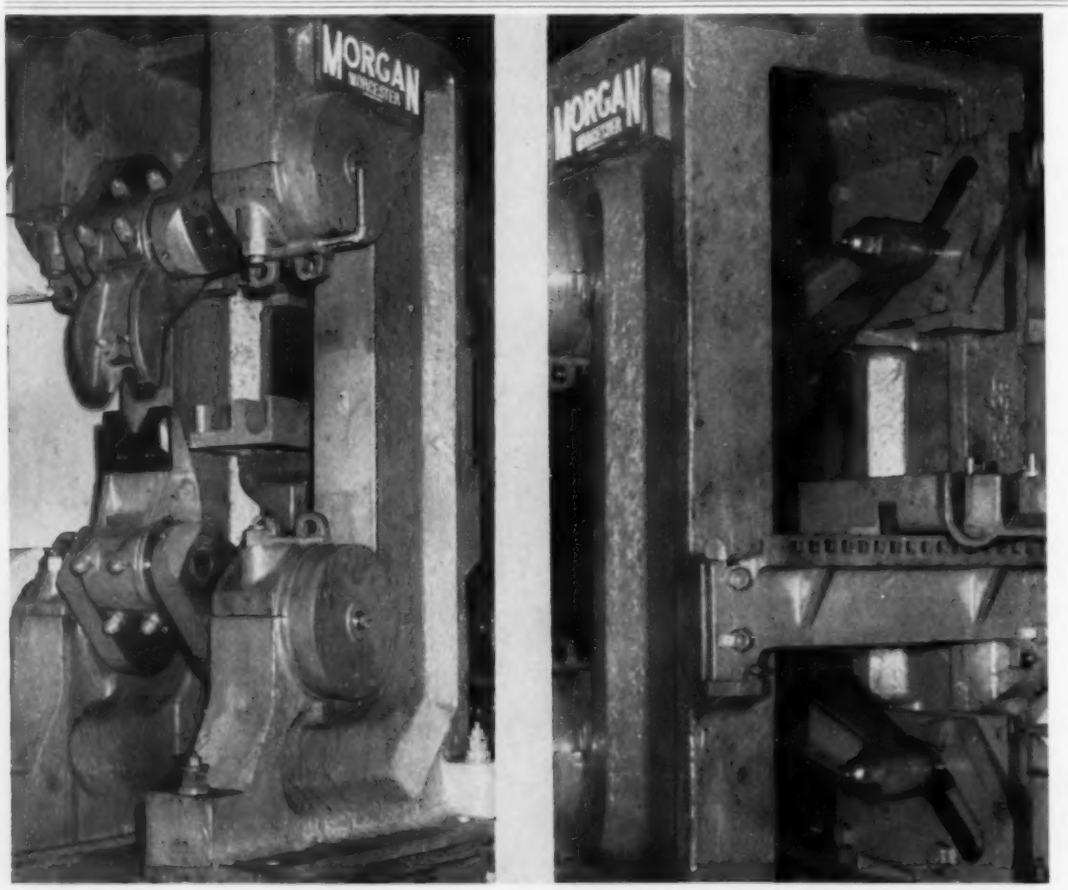


Figure 4 — Electric crop and cobble shear. Left shows delivery side; right shows entering side.

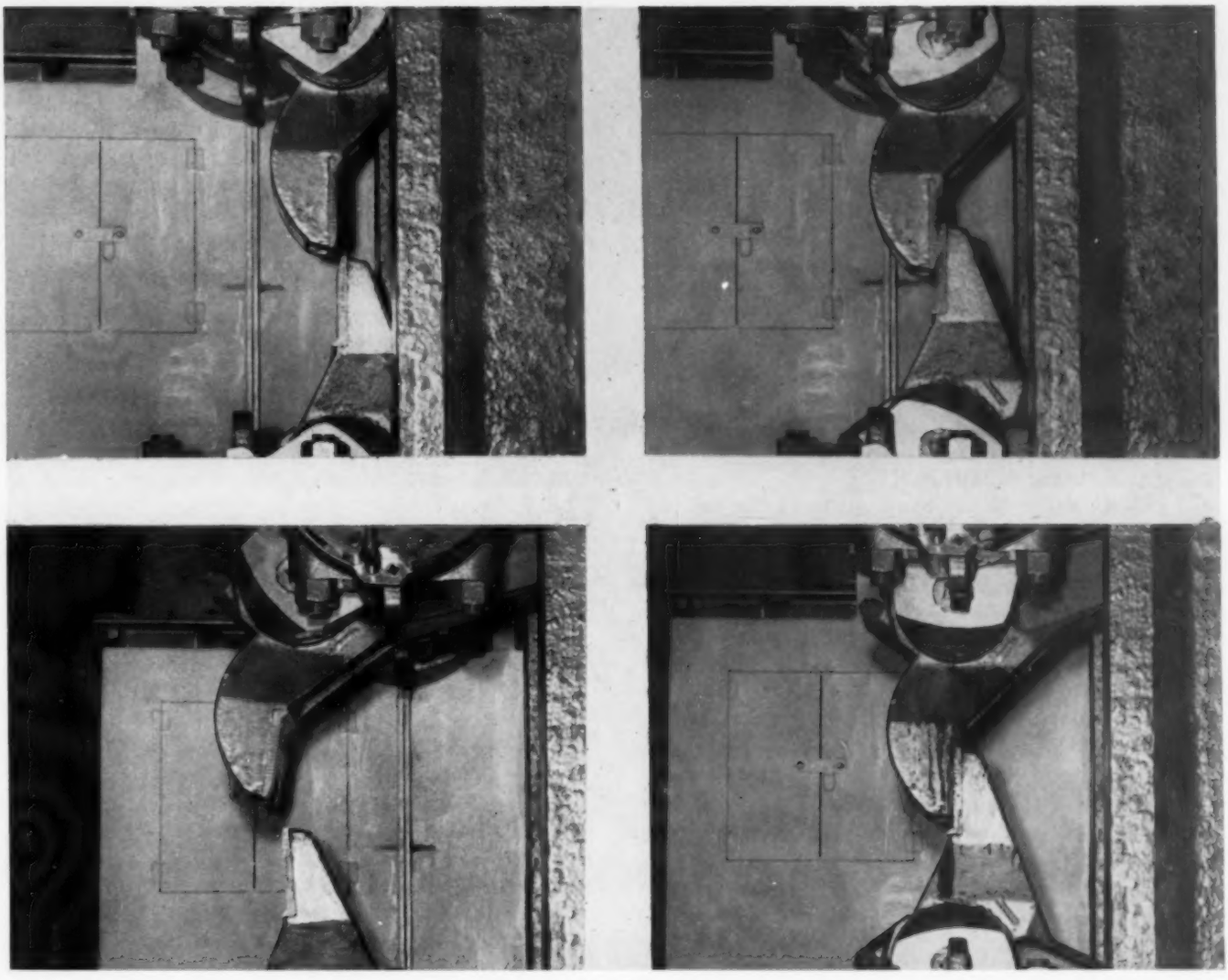


Figure 5 — Electric crop and cobble shear, shows parallel motion of knives in clockwise sequence, starting at upper left.

ciples were developed which offered promise of providing a complete solution.

The principles* of mechanical design which were finally adopted for construction are shown in Figure 4. Two crankshafts are employed, mounted in bearings at the ends of a "C" shaped shear frame. Each crankshaft carries a knife holder which is constructed with an extended tail rod. A sturdy cam follower at the end of each tail rod operates in a grooved cam plate which serves to keep the shear knives parallel to each other, and normal to the billet during the cutting portion of the cycle. After the cut is completed, the shape of the cam accelerates the forward motion of the knives to clear the path of the oncoming front end. The two crankshafts are connected to equal gears through gear type couplings, and in turn two pinions, each driven by an individual d-c motor, engage each of the crank gears.

Figure 5 shows the parallel and forward motion of the shear knives during the cutting portion of the shear cycle. Here the successive positions are shown in clockwise sequence, starting at upper left.

If a shear of this type were to operate continuously at mill delivery speed, it would divide the product into lengths corresponding to the circumference of the crank circle. To obtain a length of cut greater or smaller than the circumference of the crank circle, the speed of the shear must be lowered or raised briefly between cuts to permit more or less of the product being sheared to pass through the knives. As will appear later, the relation between the crank circle circumference and the chosen lengths of cut usually call for retardation rather than acceleration of the shear between cuts. The retarded motion of the shear between cuts must necessarily be maintained with repetitive accuracy, and must be responsive to changes in speed of the billet, if the divided lengths are to be uniform. In some cases where only long lengths are required, the shear can be brought to rest after each cut and reaccelerated from rest for each successive cut.

Application of these principles to a specific shearing and rolling program presents numerous problems, and involves extensive calculation to determine the arrangement best suited for the requirements. The size of the crank circle and the proportions of stressed parts necessarily must be selected for the most severe shearing operation included in the rolling program; this of course involves not only the size of section to be sheared but its composition and temperature as well. This operation, though tedious, invokes no new design principles. Selection of the most suitable motor rating and gear ratio,

*U. S. Patent No. 2,157,000.

however, requires repeated trial and error calculations. Previous authors[4,5] have dealt intelligently with equations and graphs for selecting the optimum gear ratio for accelerating a heavy inertia, and there are excellent examples of such work. Unfortunately, these analyses cannot be applied to the case in question, because they are predicated upon the existence of a constant inertia external to the driving motor. The width of gear face required to assure adequate capacity depends upon the gear ratio, and since the cranks and gears represent a considerable proportion of the total inertia to be accelerated, this inertia external to the motor changes with each change of gear ratio.

Even the inertia of the motor pinions and couplings must be considered. For example, in a typical billet shear with a 5:1 gear ratio, the pinion WK^2 is only 50 lb-ft ^{2}. If the gear ratio be reduced to 1.75:1 the pinion WK^2 becomes 1000 lb-ft ^{2}.

The load applied to the crank gears by the driving pinions, during the brief interval when the maximum shearing load occurs, depends upon the inertia of the gears themselves. Upon reflection, it will be clear that a substantial portion of the force required for shearing, during the brief period in which the force is applied, is provided by the stored energy of the rotating parts, and that only those rotating parts which are on the motor side of the tooth engagement between pinion and gear contribute to the energy which must pass through the gear mesh. Thus both the applied tooth load and the external inertia vary with each change of gear ratio, so that the selection of the optimum gear ratio for a given motor size requires numerous trial and error calculations. Likewise, there is no assurance in the initial stages of the calculations that the use of two motors on each crank gear represents the most advantageous arrangement. One must necessarily consider several different standard sizes and numbers of motors, determining by trial and error the optimum gear ratio for each arrangement, in order to arrive at the design which is most suitable, both economically and technically, for the requirements of the installation.

The objective in this analysis, of course, is to select the arrangement which will resolve in the most economical way the dilemma between the highest possible acceleration rate and the provision of sufficient stored energy to complete the most severe shearing operation at minimum operating speed. From this standpoint it would be convenient if normal rolling schedules were reversed, with the largest section being delivered at the highest speed. At low speed the rotating parts of the shear and drive have the least stored energy, (kinetic energy being proportional to the square of velocity), yet the stored energy available in the system at minimum speed must be sufficient to provide, with an acceptable speed drop, a large part of the energy required for shearing. Because the force and torque required for shearing billets are very large, in comparison for example to those involved in shearing thin strip, the torque available from motors of acceptable size is quite inadequate to perform the shearing operation. This dilemma can be resolved, at the expense of perspiration, if the range of rolling speed remains within reasonable limits. For example, if a shear is to deal with 4 x 4-in. billets at 350 fpm, a design can be selected which will meet this requirement and which also will permit operation of the shear on smaller sections at a speed of 800 fpm. On the other hand, if the delivery speed of the 4 x 4-in. billet be reduced to 150 fpm, about four times as much inertia will be required in the system to shear the 4 x 4-in. section successfully, and the maximum speed to which this inertia can be accelerated in less than one revolution of the shear will be limited to about 500 fpm. Even this limitation can be extended, if necessary, by use of a flywheel which can be brought into or dropped out of engagement by a clutch, the flywheel being used during the shearing of the largest sections at minimum speed, and being idle when higher speeds are employed.

The requirements that establish the starting point for the design of a shear include the dimensions and maximum and minimum speeds of the various sections which are to be sheared, and the range of lengths into which each product is to be divided. These factors vary so widely between different mills that a study of a par-

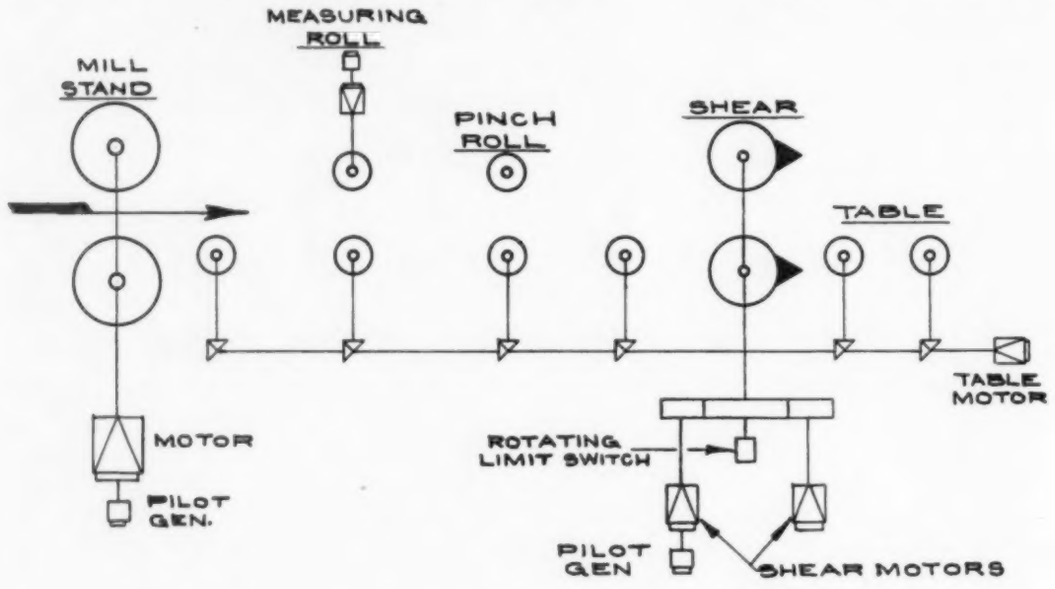


Figure 6 — Schematic diagram of billet shear, with associated measuring roll, pinch roll and table.

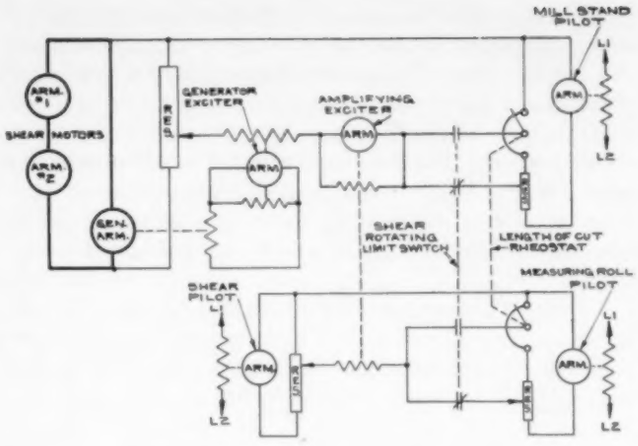


Figure 7 — Partial elementary diagram shows basic armature, field and regulating circuits for electric billet shear.

ticular example is of little value for any other case. Furthermore, the interrelation between these factors is so complex in the aggregate that no comprehensive general formula has yet been developed. For these reasons, no specific example of calculations has been included.

Special principles* of electrical control are required in these shears, and these principles will be of interest. Figure 6 is a schematic diagram of a typical billet mill installation. Between the last stand of the mill and the shear are located the measuring and pinch rolls. Since the mill rolls are grooved and vary in diameter, the speed of the finishing stand may or may not be a true indication of billet speed. For this reason, a measuring roll located between the finishing stand and the shear and riding on the surface of the billet is employed to give a true indication of billet speed. The pinch rolls serve to control the speed of the billet after the tail end leaves the finishing stand.

*U. S. Patent Nos. 2,425,484; 2,500,999.

Figure 7 shows a partial elementary diagram of the basic armature, field, and regulating circuits of a typical billet shear. The shear motors are supplied with adjustable voltage power from a generator. The entire speed range of the motors is obtained through generator voltage control.

To synchronize the speed of the shear knives with the speed of the billet, coarse and vernier speed regulators are used. The coarse regulator compares a portion of the shear generator voltage with the finishing stand pilot voltage as a reference, so that the difference excites the generator field exciter to produce the desired generator output voltage. The vernier regulator compares a portion of the shear pilot generator voltage, representing shear speed, with a portion of the voltage from the measuring roll pilot generator. The difference between these two voltages excites an amplifying exciter. The output of the amplifying exciter bucks or boosts the roll stand pilot generator voltage in the coarse regulating reference circuit to produce the desired shear motor speed with a high degree of accuracy.

The shear speed is synchronized with the billet speed only during the cutting portion of the shear cycle. Just as soon as the shear knives have completed the cut and cleared the billet, the regulating circuit is deliberately upset, which causes the shear motors to retard quickly to a preset slow speed. The shear continues to run briefly at this reduced speed, and then re-accelerates to billet speed in time to make the next cut. The signals for slowing down and re-accelerating are obtained from a rotary limit switch geared 1:1 to the shear.

Figure 8 shows theoretical curves of shear speed vs. shear degrees, and also shear speed vs. time, for a billet speed of 800 fpm. The solid lines represent a 30-ft length of cut, for which a low speed of 100 fpm is required between cuts. The dotted lines represent the correspond-

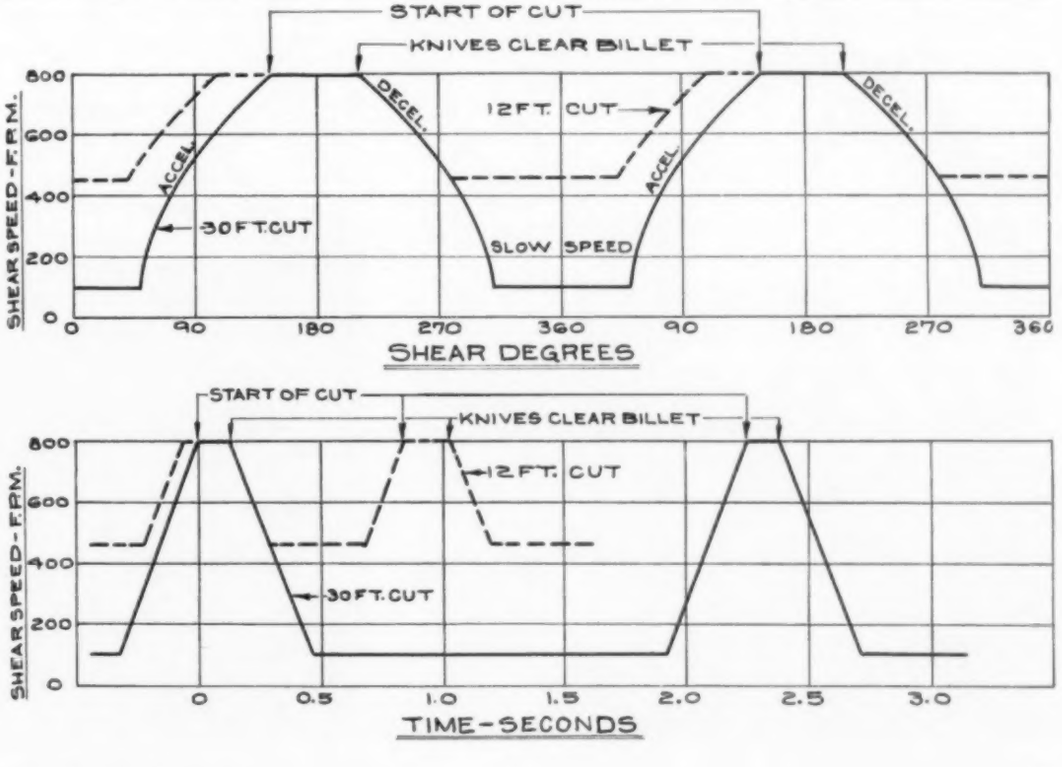


Figure 8 — Theoretical speed cycle of electric billet shear. Solid lines are for 30-ft length of cut, dotted lines for 12-ft length of cut.

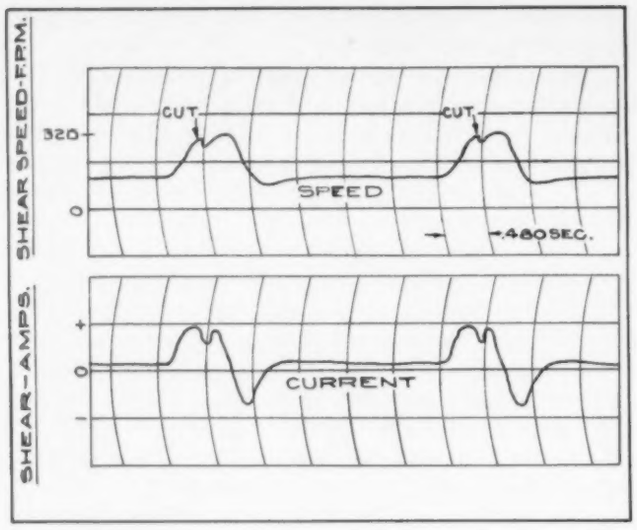


Figure 9 — Oscillograph record shows shearing of 4 x 4 in. billets.

ing conditions for a 12-ft cut, in which case the shear slows down to 470 fpm between cuts. Thus the length of cut is determined by the pre-set slow speed of the shear between successive cuts.

Figure 9 is a reproduction of an oscillograph record taken on a 4 x 4-in. billet shear. The top curve shows shear speed while the lower curve shows motor current.

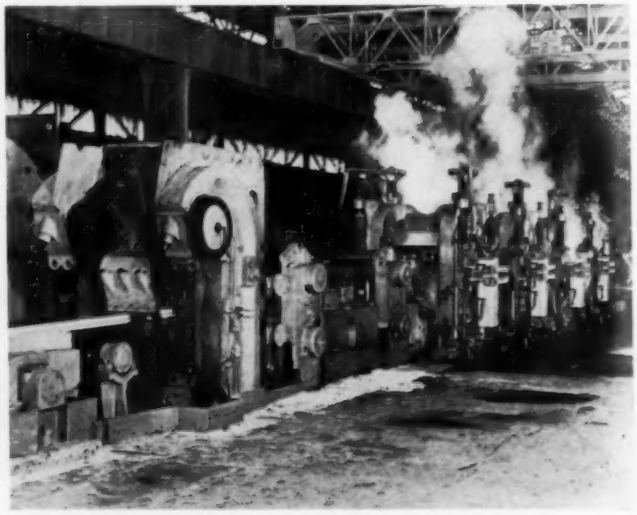
The shear shown in Figure 4 was designed for crop and cobble operation and was installed early in 1947 between the roughing and intermediate stands of a bar mill. This particular shear is capable of cutting alloy steel squares or rounds up to 7.5 sq in. in area, within a speed range of 120/720 fpm. The shear is driven by four AISE-612 motors, supplied with adjustable voltage power from a suitable motor-generator set. The shear is started automatically by a flag switch located ahead of the shear. The shear starts, accelerates to bar speed, makes a crop cut, slows down and then stops, without making a second cut. In case of a cobble in the finishing end of the mill, the shear is started by the operator and runs continuously, dividing the remaining portion of the bar into 6-ft lengths suitable for charging boxes. At the instant the shear is started for cobble cutting, the trough following the shear opens automatically, so that the cobble-cut lengths drop into a scrap box.

Before this shear was installed, the authors checked the stress in the shear frame experimentally by mounting resistance wire strain gauges on the frame and loading the shear by means of hydraulic jack placed between the two cranks. These observations produced a linear relation between stress and load, and suggested the possibility of using the calibrated shear frame to measure directly, for the first time, the loads which occurred during high-speed shearing. The anticipated result was so attractive that the strain gauges were left in place, and arrangements were made to take oscillograph records as soon as the shear went into operation. Like many other good ideas, this one failed to produce the expected result. The oscillograph record showed only a barely perceptable deflection for each cut, and investigation disclosed that the deflection lagged appreciably behind the brief interval when the knives were engaged with the bar. This gave us another convincing demonstration of the effects of inertia; the mass of the shear frame resisted instantaneous deflection, so that only an insignificant part of the shearing force applied at the knives was transmitted through the shear frame to the strain gauges. Fortunately instantaneous values of shearing force could be calculated from the oscillograph records of speed, voltage and current.

Figure 10 illustrates the installation of a typical billet shear. Two shears of this type are now in operation in England, cutting billets on the corner up to 4-in. sq at 250/650 fpm, and two additional shears are under construction for mills to be located in India and the U.S.A. One of the latter two will be installed on a billet and slab mill at a new Eastern steel plant now under construction. This shear is designed for 4 x 4-in. billets or 3½ x 12¼-in. slabs at delivery speeds of 420/840 fpm. The range of lengths to be cut is from 13 to 40 feet. A bar mill at this same plant will also include an electric crop and coble shear similar to the one previously described.

Operation of electric billet shears in the field has brought to light several interesting corollary problems. One of these is the problem of measuring the length of cut immediately after the first cut length is sheared and while the sheared bar is in motion. We have recently developed a device for this purpose which is expected to assist the shear operator materially. The device consists essentially of a photo-electric pickup head and an electronic counter. A disc with equally spaced holes is driven from the measuring roll located between the finishing stand and the shear. This disc rotates between a photo-electric cell and a light source. The space between successive holes in the disc corresponds to 0.01 feet of travel of the measuring roll. As the disc rotates, each hole permits a pulse of light to pass through to the photo-cell. The photo-cell pulses are fed in turn to an electronic counter, which gives the operator a visual summary of the total number of pulses to indicate the length that is actually being cut. A contact on the rotating limit switch, geared 1:1 to the shear, signals the electronic counter to start at the instant the shear

Figure 10 — Electric billet shear is shown in operation.



starts to cut, and counting continues until the shear reaches this same point again on its next revolution. The length of the section just cut can then be read directly from the electronic counter. If the result is not the desired length, an adjustment of the shear control can be made immediately to correct the error.

We have briefly reviewed in this paper the electrical and mechanical problems involved in the design of flying shears. It can be seen clearly that these problems can be solved only by the cooperation of the mechanical and electrical designers and the steel mill operators. Research and development are continuing in order that we may be fully prepared to meet future shearing requirements as they develop.

BIBLIOGRAPHY

1. *"The Morgans of Worcester,"* an address presented by PHILIP M. MORGAN before the Newcomen Society of England, meeting in Worcester September 13, 1951.

2. *"Flying Shears"* by V. E. EDWARDS, an address to Morgan Construction Co. employees, December 13, 1920.

3. *"Electric Drives for Flying Shears,"* by L. A. UMANSKY, 1932-34 Proceedings AISE, p. 667.

4. *"Steel Mill Auxiliary Drives,"* by L. A. UMANSKY, G. E. Review, October-November 1922.

5. *"Selecting Drive Motors for Flying Shears,"* by WARREN REID, 1952 Proceedings AISE, p. 103.

DISCUSSION

PRESENTED BY

E. C. PETERSON, Engineer, Birdsboro Steel Foundry and Machine Co., Birdsboro, Pa.

C. B. HUSTON, Commercial Engineer, General Electric Co., Schenectady, N. Y.

F. C. FENNELL, Steel Mill Engineer, Westinghouse Electric Corp., East Pittsburgh, Pa.

J. H. HITCHCOCK, Director of Research, Morgan Construction Co., Worcester, Mass.

E. S. MURRAH, Electrical Engineer, Morgan Construction Co., Worcester, Mass.

E. C. Peterson: It is certainly true, that the modern continuous mill, which is becoming so popular, depends completely, for practical operation, on the availability of satisfactory flying shears. We have had numerous occasions to witness the shear, which the authors showed in their Figure 4, in operation, and we never fail to be impressed both by the efficiency of the machine, and the ingenuity of its designers.

It is possible in some cases, however, to apply a relatively simple type of shear as shown in Figure 11, of the simple rotating drum type. This can be done where the thickness of the bar is such that the ratio of drum diameter to bar thickness can be kept large without getting an unwieldy size drum, and in this case ovals and squares can be given a very satisfactory cut on the flat for cropping purposes. This particular shear is used in a two-strand continuous bar mill, and the top knife is arranged for movement from one strand to another by

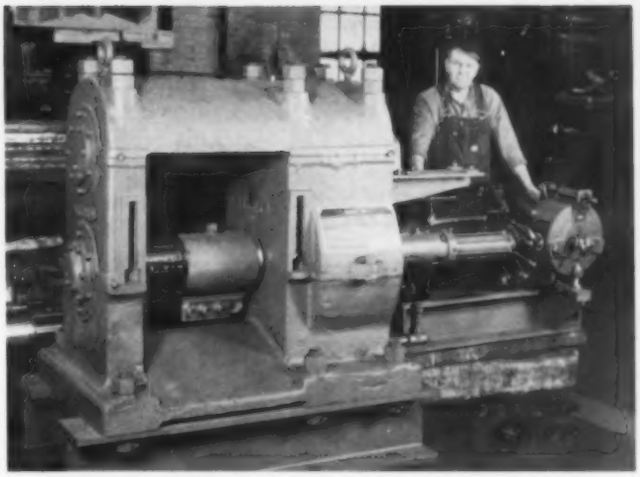


Figure 11 — The shear shown is of the simple rotating drum-type design.

means of an air cylinder located to the right of the shear frame, and this air cylinder can be arranged for automatic operation, if so desired.

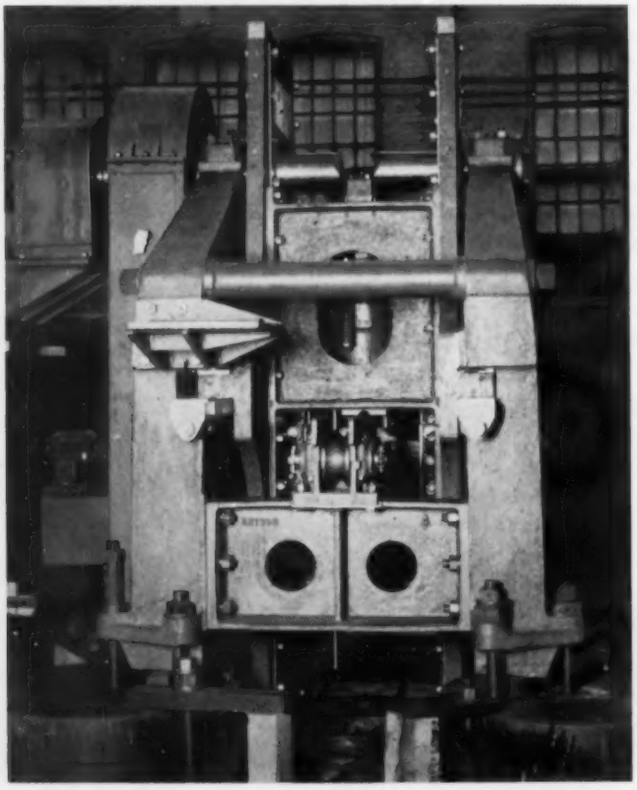
The authors pointed out in their paper very clearly the tremendous effect that operating speed has on the requirements of an electrical drive for a flying shear. An interesting illustration of this point might be that this particular shear will cut bars at speeds up to 700 fpm when driven with a 15-hp mill motor with magnetic control and a gear ratio of about two and one-half to one between the motor and shear drums. Figure 12 shows a set of flying shears for use at the finishing end of the same mill, cutting cooling bed lengths up to 2400 fpm. This shear requires a 100-hp motor with variable voltage control. As the authors pointed out, you don't always get a flying shear to run faster by applying a bigger motor, because the motor finally gets to the point where because of its own armature inertia it can't get itself started and stopped in the required time let alone an external load. Therefore in designing this faster shear the gear ratio was eliminated entirely, so that the motor is geared directly to the drum and makes only one turn for a shear cycle, and in addition the drum diameter was increased 40 per cent over that of the shear previously shown. Since the mill also finishes two strands onto the cooling bed, two shears were furnished, assembled into the mill in the position shown here.

I would like to ask the authors a question about

Figure 12 — These shears are used in the finishing end of a bar mill, cutting bars at rates up to 2400 fpm.

the shear which they showed in their Figure 5. I would like to inquire as to whether the arrangement of tail rods and cams is such as to provide a uniform forward lineal motion of shear blades during the cutting part of the cycle. We have wrestled with this problem ourselves, recently. We had a requirement for a flying shear to stand in back of a continuous bar mill and cut cooling bed lengths, but this shear also had to minimize or eliminate almost completely the hook of the bars at the ends, which is the usual accompaniment of hot shearing. We have been building for years a stationary up and down cut shear with a heavy hold down gag which clamps the bar to the lower knife anvil during the cutting portion of the cycle, and this gag has been so effective in eliminating end hook that we decided we should use the same sort of action in our flying shear. So we developed the shear shown in our Figure 13. The up and down cycle incorporates in its design a hold down gag which comes down and locks the bar firmly in position, with a pressure equal to or greater than the cutting pressure during the cutting part of the cycle, and it holds the clumped end of the bar on table level at all times. However, we are talking about rather large bars and the shear was located quite close to the finishing end of the bar mill and driven by a crank. It is obvious that when you drive something with a crank and you have forward moving parts, and constant angular velocity of the cranks, the forward lineal velocity of the moving cutting parts will vary as the shear crank approaches and leaves the vertical position. There was not very much variation with our cutting cycle, but we were somewhat concerned about it, especially because the bar is clamped so firmly in the shear, and we even went so far as to discuss and develop with the electrical supplier, an electrical modification whereby we could introduce a slight dip in the angular velocity of the cranks at the moment of cutting to try to even cut the forward lineal velocity. However, we didn't adopt that additional complication. We decided to see how things would work out. The shear is in operation, and there is no apparent effect, either on the bar or on the machinery, from this slight theoretical variation in linear velocity of the shearing parts during the cutting part of the cycle.

Figure 13 — This design incorporates a heavy hold down gag which clamps the bar to the lower knife anvil during the cutting portion of the cycle.



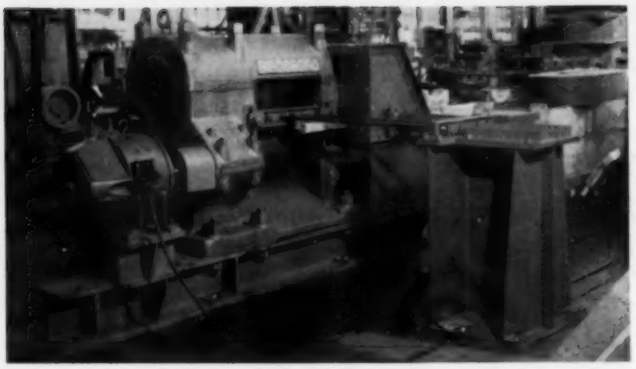


Figure 14 — In this design, as the mill speed is varied, the shear speed automatically varies with it.

The authors also discussed a very interesting measuring device which employs a roller rolling on the bar to indicate the exact length that is being cut. We also had an interesting application recently where we were required to provide a flying shear in back of a continuous rod mill. This particular mill is fed by a continuous casting machine which feeds an endless billet, so obviously it produces an endless rod, and the flying shear is required to measure off a coil length and cut and shift the rod into the next set of coilers. The customer resisted our suggestions for applying the size of mill motor required, for start and stop operation at the speeds he wanted, because, as he said, "If I had the time, I could go out myself and cut it with an axe, so I don't see why we need a motor of that size." So we developed the shear shown in Figure 14. This shear is constant running, and is driven by a 5-hp d-c motor and this motor is powered from the main mill bus, in such a manner that as the mill speed is varied the shear speed automatically goes with it. There is field regulation, of course, to compensate for finishing roll pitch diameter. In the box on the far side is located a mechanical counting device which measures off the required coil length and then actuates the shear in such a manner as to cut two strands. You can see that there are two guide pipes, two strands going through the shear at once, and it cuts the two strands and at the same time actuates a switching device located behind the shear, to switch the new coils into two new coilers.

C. B. Huston: The authors of this article have given us an excellent description of a unique tool, operated in a very special manner, to do a very particular job in the steel industry. I have said on many previous occasions that more time and effort have been spent in the past many years in designing and building of shears for the cutting of metal while it is being processed in one form or another, than for almost any other operation, be it rolling or the handling of the steel.

The electrical driven billet shear usually falls into either of two classes, one, those composed of gears, cranks and various mechanical parts flying around in space so that the knives may be brought together for cutting at stated intervals; and two, those of a simpler mechanical design on which dependence is placed on the electrical drive and its control to accomplish the cutting at the same stated intervals. The equipment of which the authors have told you this morning falls into the latter class. It is fitting that this paper is presented here in Buffalo because it is in one of the major steel plants close to the city, that the first of this design of electrical driven billet shear was placed in operation.

Not all mechanical designers appreciate some of the characteristics of electrical drives, good or bad, and the problems of overcoming some difficulties that naturally arise. For instance, inherent lag in the building up of field circuits, or electrical inertia, so to speak, is not always understood. It is not sufficient to simply close a field circuit and expect the generator to develop instantly the voltage that may be required to serve the motor or motors driving the shear. Force must be applied to cause the power to be generated quickly for acceleration and again force applied in a negative manner to remove voltage so that the shear may be stopped. It is not always within the capacity of the electrical drive to start, accelerate, drive through the cut, slow down, and then accurately stop within one revolution of the shear blades. If 240 degrees or so of angular rotation are needed to accelerate from stand still, an equal amount in degrees, or nearly so, will be needed for stopping. Consequently, an excitation in the reverse direction, or plugging, may be applied and the rotation allowed to be carried past the initial starting point when it is then reversed and the blades slowly returned to the original starting position. In this way the high values of mechanical inertias are more easily handled as well as more accurate positioning of stopping is obtained.

One other problem is the time delay in the control of the electrical circuits which may come from operating contact-making devices such as contactors and relays. The variation in the time of operation of even small relays may interfere with the accuracy of the cutting of material. Therefore, many times the fields of the controlling exciter must be handled direct on the master which in this case is the limit switch driven by the shear itself.

For cropping service only, a high degree of matching between the rotation of the knives and the forward travel of the billet may not be required, but it does become necessary to accurately stop the shear in its initial resting position so that when again restarting the length of the crop will be the same. The latter is also influenced by the type of limit switch used to detect when the front end of the billet is coming along. Here the design of the mechanical and electrical equipment must be closely allied.

On the first shear of this design built for cutting to length, where the speed of the shear is varied between cuts, the governing pilot was driven from the main mill motor, this being a geared multi-stand mill. Exhaustive tests were conducted on the shear before the mill went into service, and a very high degree of repetitive accuracy was obtained. When the mill was placed into actual service, variations crept in because the metal was not truly following the speed of the mill. The operators were forced to study the rolling adjustment of the several stands so that there was a constant flow of material through the last stand. Conditions of this sort have led to the use of the measuring roll, which again calls for close correlation between the mechanical and electrical designers, as well as the proper understanding by the user in order to obtain the best of results. Slippage between the metal and the measuring rolls can be just as aggrevating as in the case where the pilot was driven by the mill.

It is observed from what has been stated in the article, that when cutting to length, a high degree of accuracy is needed in the speed relationship of the shear to the forward progress of the billet. It is here that the vernier control comes into play. The signal obtained from the differential between the speed of the shear and the speed of the measuring rolls is amplified and applied to regulate the speed of the drive. Contrary to first belief, it is more important to closely synchronize the speed of the shear when running, during the slow down period, than when actually cutting the steel. This is even more true when cutting long lengths than short ones, all because of the greater time consumed, as well as the lower speed to which the shear is adjusted between cuts.

Because of the variation in the size of billets being rolled, the speeds at which material is being delivered, and the variation in length of cuts to be made, it is difficult to obtain a calibration of controlling rheostats in measured lengths of billets. The operator is, instead, supplied with a chart by which the various settings may be made. At best this is only a makeshift, subject to the wrong interpretation and improper execution. Consequently, the electronic counter to which the authors have referred is a very important adjunct to the convenience in operating the equipment.

It can be seen from what has been stated that the electric drive and its control have a most important duty to perform and should in no sense be treated lightly. It can literally be said that the electric control becomes the "brains" of the shear.

F. C. Fennell: Some time ago, someone described the electric drive for a flying shear as an electrical explosion. I think perhaps a better term would be that it is a controlled electrical explosion. It is an explosion in the sense that the forces required are very large and of short duration, but it is a controlled explosion because both the amount of these forces and their time of duration are precisely controlled. Figure 15 shows an oscillograph record taken on a start-stop shear that illustrates how quickly some of these cycles are over.

The shear in this illustration operated on bar speeds to 800 fpm, and the gearing was one-to-one ratio. The top curve showing shear speed is the one that will be of most interest to the audience. It shows that the acceleration to speed and deceleration was over in less than one-half second, while the remainder of the cycle time was taken in creeping into the final stop position. Some

idea of the control problems associated with this shear can be gained when you realize that with a one-to-one ratio, the shear makes one revolution and the motor also makes only one revolution, in the time interval shown. The motor accelerated to full speed, slowed down and crept into the final stop position in only one complete revolution of travel.

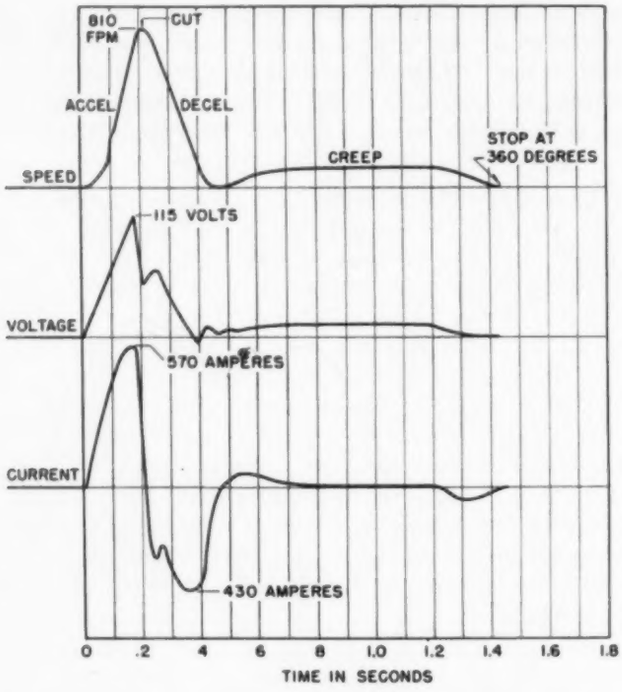


Figure 15 — An oscillograph, showing operating cycle of 800 fpm flying shear, illustrates the high speed at which this operation takes place.

I think perhaps one of the most troublesome devices on flying shears are the flag switches which start the cycle. Electrical manufacturers make several devices which are used for these flag switches, including the measuring roll devices already mentioned, limit switches which operate from mechanical triggers, photo-electric relays, and the electronic units which measure resistance between insulated table rollers and ground and detect the passage of the bar over the insulated roller by the change in resistance. As in all steel mill applications of electrical equipment, the experience of operating people is the best guide for the manufacturer in designing or applying devices least likely to give trouble. Comments on experiences with flag switches, particularly as to limitations encountered in bar size or bar speed would be very helpful to members of the AISE.

J. H. Hitchcock: Mr. Peterson asked a question regarding the shape of the cam with relation to its effect upon the forward motion of the knives. During the cutting part of the cycle, the follower at the end of the tail rod follows a path in a circular arc corresponding in radius to the radius of the crank, so that the knives are kept in parallel positions, normal to the axis of the bar, throughout the zone in which the cut is made. The relation of the forward speed of the knives to the speed of angular rotation is one of simple trigonometry. If the speed of angular rotation remained constant, the forward speed of the knives would increase continuously from the instant of first contact to completion of the cut. However, there is always a drop in speed during the cut, which offers opportunity to match knife speed to bar speed quite closely throughout the cut. We like to run the shear at an initial speed somewhat greater than bar speed, so that the angular relationship at start of cut will make the forward speed of the knives approximately equal to bar speed. As the cut proceeds, the changes in angular relation and rotating tends to offset each other, so that no great disparity between knife speed and bar speed occurs.

It would be interesting to Ed Murrah and me to know the speed of the last shear Mr. Peterson mentioned in which he illustrated the mechanical counting device employed, to divide continuously cast product into bundles of more or less uniform weight.

E. C. Peterson: This shear cuts at speeds up to 1050 fpm.

E. S. Murrah: There is one thing I would like to point out regarding the drum shear mentioned by Mr. Peterson. This type of shear has its limitations as to the thickness of material that it can cut, and is usually limited to thin materials. As pointed out in our paper, both the mechanical and electrical design problems increase greatly with the thickness of material to be sheared.

We also build drum type shears, but they have been limited to thin strip and small bars.

There is another point that I would like to mention regarding the billet shear. The cam plate that guides the tail rod, is so designed that just as soon as the cut is completed, the forward speed of the knives becomes greater than the speed of the billet.

Mr. Fennell brought up an interesting point regarding flag switches. On shears where the product is large and speed is low, we use mechanical flag switches. The flag or trigger mechanism that operates the limit switch should be vertical ; otherwise there is a chance of error, caused by the oncoming billet not hitting the flag at the same point every time.

Photo-electric cells have also been used for flag switch, but they have to be protected against heat and also cobbles. The photo-electric cells also have to be kept clean and free of scale.

Load relays, operating off load from the stand motor, have also been used, but their chief drawback is the range of pickup required. Another flag switch problem is for cooling bed shears for merchant bar mills, where the product is small and the delivery speed may be 2000 to 3000 fpm. We use an insulated table roller in combination with a resistance operated electronic relay, which has proven very satisfactory.

We agree with Mr. Fennell, that flag switches are always a problem for shear or in fact for any other mill auxiliary drive. Comments from the operating people, regarding their experiences with various types of flag switches would be valuable to the men in the steel industry.

By JOHN E KINNEY, Sanitary Engineer, Ohio River Valley Water Sanitation Commission, Cincinnati, Ohio

POLLUTION CONTROL CAN BE REALISTIC

. . . . cooperation between industry, federal, state and local goverments, and the Ohio River Valley Water Sanitation Commission will help in finding a solution to the river pollution problem . . . .

▲WEALTH has many forms. It includes resources, power, and labor, as well as precious metals. But the full utilization of these forms of wealth depends in large measure upon the activities of our banking institution, the medium through which the value of one phase of wealth can be translated to another. Thus we see the banking institution as a vital cog if our economy is to continue.

There are certain fundamental practices in banking. The bank, to show its solvency or its ability to continue in business, at regular intervals discloses total assets and liabilities. The assets include cash on hand available for immediate demands, and funds set aside for future use that are presently earning interest and helping to support the upkeep of the institution. The bank supplies its greatest assistance to the community when its assets are put to the best use consistent with financial stability.

The credit rating of a prospective borrower is an important factor in determining whether he gets the loan and in determining the interest rate. The bank determines the length of time that it can afford to lose control of the funds. In order to assure the depositors and creditors that the bank is operating according to proper practice, examiners check the bank operating procedures. Many banks have branch offices so as to better assist their clients. Into these branch offices as well as the main office, the clients deposit money and thus increase the stability of the bank.

The river is a banking institution in its truest sense of the word. All of the operations described for the banking institution can be shown to have a counterpart in the role of the river as a vital part of community development.

The river is a dynamic living entity. It has the ability to store up tangible resources and to permit their disbursement at a later date. The wastes discharged to a river constitute the liabilities that are assumed by the river. The assets carried by the river are measured in terms of such things as its alkalinity and dissolved oxygen. The liabilities are measured by the waste loads discharged to the river—both industrial and domestic.

Just as the bank works to gain an increase in assets through the interest that it charges, so also does the river provide for an increase in its assets through natural purification abilities with which it has been endowed. These powers are expressed in terms of biological oxidation, aeration, sedimentation and volatilization.

The Ohio River then is the home office of a bank—its tributaries are the branch offices. Only by considering it in this way can we visualize the effects of waste discharges in any part of the basin on the rest of the basin. This approach also negates the very common error that when the discharge of wastes into a tributary river is exceptionally heavy, as in the Mahoning, the river can be considered only as a vehicle for carrying wastes without checking its effect on the main stem of the river. Here, in effect, is a run on the branch office of the bank. The resources at the branch office may be sufficient to handle the demand, but there is likelihood that the run on the branch office may have an effect on the main office.

But runs on banks are not peculiar to branch offices. Nor are waste loads discharged only to tributary streams.

Visualize a river fed only from mountain streams meandering through fertile farm land. There is little soil erosion, so the water is clear, high in dissolved oxygen and abounding with fish life. A pretty picture to the fisherman, the farmer and the nature lover, but of no actual value in the manufacturing economy. But it does have a high potential value. When this stream reaches a community, there is a supply of clean water for processing and a water free of taste and odor that makes life pleasant in the community. There is also another value to industry in the stream—the assimilative capacity of the stream for the body wastes and the industrial waste waters produced in the community. The stream has a miraculous power of self-purification, and can clean up wastes discharged to it—but a power with limitations.

If the capability of the stream to absorb these wastes is not exceeded, and there is sufficient time of flow in the river to permit reviving the resources before the next town or tributary river discharges a waste load, then no real damage has been done to the stream. In fact, the effect has been just the opposite. The resources of the river have been properly utilized and have aided the economic life of the community.

A series of cities or tributaries discharging wastes into the river would be comparable to a run on the bank. If these waste loads or liabilities exceed the available assets, insolvency results. The river no longer is a useful cog in society, but rather resembles the begging leper. The odors from the septic stream indicate an unhealthy condition—and one that can spread disease to the community.

Unfortunately, the usual condition to be found along a river is a series of communities or industries. This proximity encourages industrial progress but it makes pollution abatement control mandatory.

The regulations adopted for this control will determine whether the abatement program will be realistic. A guide to formulating a realistic program can be found in the parallelism of banking controls.

The bank is of most value to the community when it permits the maximum utilization of its assets. This can be accomplished with security only by considering each individual loan application in terms of the applicant's responsibility to his obligations, which measures the risk of borrowing and influences the rate of interest that will be charged. The alternative would be to charge the same rate of interest to all and make the rate that which would be charged to the poorest risk.

The same situation prevails in setting waste treatment requirements. All companies or cities can be required to provide the same degree of treatment or removal of waste contaminants, or, the requirements can vary. The first procedure does not permit the fullest utilization of the stream's powers of self-purification; the second can.

Setting the same requirements for all plants provides for easier administration of the program. It is equivalent to using one rate of interest with the same schedule of payments for all loans. Under some circumstances this may be feasible. But as an "only" procedure it does not provide the necessary flexibility for full utilization of wealth.

If you agree that the requirements for plants should vary, and should depend on a consideration of the self-purification capacity of a stream or the dilution available in a stream, then another consideration deserves attention.

What is the purpose of pollution abatement? What are we protecting? Is it fish life, drinking water supplies, industrial process water? In other words, the use of the stream should be considered. Depending on the use of the stream, the desired quality of the stream may vary. With a variation in the desired quality of the stream, greater or smaller waste loads may be discharged to the river without impairing this quality. Under this setup, a recognized usage of a stream is carrying wastes as long as the transmission of wastes does not interfere with the other recognized uses. This approach calls for a determination of the relative importance of the different usages in any stretch of the river, with an economic appraisal of the treatment costs to meet the desired quality.

Realistic pollution abatement then is achieved when the waste treatment facilities constructed are adequate to protect the downstream uses, but are not operating to a degree that is wasting money. It should always be remembered that the cost of waste treatment is a cost of operation, and is included in the price of the manufactured article. The consumer pays for the quality of water he desires in the stream. Too few consumers are aware of this.

These platitudes on the need for realistic pollution abatement have been uttered often. Few, however, know how the mechanics for reducing these ideals to an actuality are established. Moreover, some of you steelmen or representatives of your companies are engaged in that activity. These men are active stockholders in the Ohio River Valley banking institution and work with the board of directors. These men are concerned with the formulation of the rules and regulations that will permit the fullest possible utilization of the assets of this community enterprise. They agree that pollution abatement must be realistic, if overall community development is to be achieved.

With a recognition of the similarity of this problem to that of banking, these men are outlining a procedure for determining waste treatment requirements that is comparable to the processing of an application for a bank loan. The need for a large bank loan must be established—so also should the need for waste treatment. The size of the loan necessary and the ability of the applicant to finance it are the next determinations. The degree of treatment required to satisfy the pollution abatement order should also be determined. Then, as the stipulations for repayment of a loan are prescribed, so also should the controls be established for checking on the operation of the waste treatment facilities.

I have referred to the men here who are active stockholders in this banking institution. They are working on one or more committees that are providing the facts that can be used as a basis for formulating these rules.

Pollution of the streams from steel mills includes phenols, pickle liquor, mill scale, flue dust, coating and plating solutions. What operations cause these wastes? What volumes are we concerned with, and what concentrations of contaminant are discharged? Unless the problem is defined there can be no intelligent answer given to the question of the degree of treatment required.

Who knows more about these wastes than the steel companies? So members of steel companies—the active stockholders that I referred to—have outlined the procedures for making waste surveys in steel plants and are preparing a description of the operations so that the board of directors may better understand the problems involved. In outlining the procedures for waste surveys, the committee had to standardize or even develop methods of analysis for these wastes. The fact that this prerequisite in some instances was missing should indicate that there has been in the past a lot of argument not based on fact.

But knowing the waste load from a plant is only part of the picture. What is the effect of this waste load on the river and on those who subsequently use the river for water supply? Information on both is needed if regulations on waste treatment requirements are to be comparable to banking requirements. Why is the loan needed? How much of a loan is required?

When wastes are dumped into a stream, they affect the water supplies for communities, for industry and

for aquatic life. In addition, there are other uses of the stream, such as for navigation, agriculture, scenic pleasure and the like. Our stockholders are evaluating the effects of wastes on these usages. Kettering Laboratory is supplying an evaluation of the data compiled by the committee on the effects of wastes on the physiology of man and animals. Eight of the country's leading aquatic life biologists are advising on the effects of these wastes on fish populations.

These active stockholders also include representatives of water treatment plants—both municipal and industrial. They will provide facts to substantiate any claims of damage. Other industries use these streams for process water. From their representatives, who are also active stockholders in this Ohio River institution, come the data on the effects of the wastes on their operations. Add to this the data compiled on natural pollution of the waterways. With all this background, the need for pollution abatement can be defined. Knowing the load from each plant permits calculating the degree of treatment required.

Once the required degree of treatment is determined, there is the problem of selecting the method of treatment that will provide that degree. The committee is also developing that data, as well as providing the basic information that will assist a plant in selecting the proper method.

The information assembled by this group is not restricted. It is published in manual form. These publications do not duplicate previous work nor are they just the result of a literature search.

These manuals and reports are a summary of the best information available on the subject—reduced to simple language able to be understood by all concerned with the problem. The data are factual—much of it previously unpublished. The authorship does not represent a single individual's opinion, but rather it is the agreement of a group of men from different companies located in different areas. The manuals evaluate all aspects of each problem without prescribing what any company must do. But the data are so arranged that any company can reasonably make its own decisions. This format also gives the regulatory agency an understanding of the limitations on any method or process.

However, supplying technical information is only one phase of the activity of these active stockholders. There are still regulations to be written. The board of directors of any organization must anticipate the eventualities as well as recognize existing conditions. So must the board of directors of the bank of the Ohio River Valley. Their regulations look toward clean waters in the future; but they must be imposed on an existing economy. The stockholders representing industry can counsel with the board on the effects that will result.

An illustration may point up some of these problems. All of us are acutely aware of the effects of phenols in water supplies. There is considerable work now underway by our active stockholders to determine the concentration of phenol in streams that actually causes trouble. Mountain streams that carry no industrial wastes carry a measurable phenol concentration—at times greater than the level reputed to cause tastes in water supplies. The human body metabolism is also the producer of phenol—and in considerable quantities. In other words, domestic sewage contains phenol. Add to this the results of a survey by the U. S. Public Health Service on drinking water supplies. In some places more than half the "phenol taste" producing substances are not phenols, but other compounds that give the same kind of taste.

All of this suggests caution to those who would say that removal of phenols from industrial wastes will give us water supplies free of taste and odor.

Reference has been made to the self-purification capacity of streams. Reduction of phenol concentration in streams by biological oxidation is an excellent example. Our active stockholder friends have conducted surveys on streams that do and do not carry sewage. Then they determined what happens when phenol wastes from ammonia stills in coke plants are added to these streams in summer and winter.

Let us assume that this background information has been established in sufficient detail so that for a given stretch of a river we can know the level of phenol due to other than industrial loads, the rate of self-purification, the flow in the stream, and a knowledge of the concentration of phenol in the stream that causes taste in water supplies as well as the concentrations that can be handled by additional treatment at these water treatment plants. A survey of the industrial waste loads has also been made. Assume that there are three coke plants in this stretch of the river—all upstream from the water plant. The problem is to determine how much phenol each plant can discharge to the river.

The waste load carried by a stream or discharged from a plant is obtained by multiplying the concentration of the pollutant by the volume of flow. We can calculate the permissible waste load that the stream can carry, and still have the concentration remain below the desired quality level. The difference between that load and the load presently carried in the river is the amount that should be removed by waste treatment.

Suppose that the stream can carry 500 lb per day of phenol and keep the concentration below the taste producing level. At the present time it is carrying 1500 lb. This means that 1,000 lb must be removed by treatment facilities.

One of the three coke plants has a dephenolizer, the other two do not. All three plants are of different coking capacities.

When the regulations are written, consideration should be given to these questions:

1. Should the individual plant be permitted to discharge a given number of pounds of phenol per day or should there be a limiting concentration of phenols in the effluent?
2. Should there be an equal percentage reduction in the phenol load from all plants or should the permissible waste load vary with the size of the plant? If variable, what would be the basis for establishing the variation?
3. Should the full assimilative capacity of the stream be utilized or should a reserve capacity be maintained for future expansion? If the full capacity is utilized, what provision should be made for future plant expansion or for the construction of a new phenol producing plant?

4. In setting requirements, should allowance be made for existing treatment facilities—such as a dephenolizer? If so, and this is in line with the proposition that treatment is a step in process, then should not credit also be given to other process changes that effect a reduction in pollution? How far should this review of operations extend?

At first glance these problems would seem to confuse the picture, and to complicate it. But some thought will show that only by facing up to these issues can we administer a realistic program. Consideration of this setup will also convince you that the solution calls for mutual cooperation and confidence between all parties concerned. There is too much involved to maintain the too common procedure of having the companies and others interested in clean waters divorce themselves of the administration of the program, and leave it solely to the pollution control agency. The days of the one man bank are over. The bank had to expand from the type of organization where the banker made and altered the rules according to his opinion of the client. Firms that do business with banks now have representatives on the board of directors.

Pollution control programs on our rivers require the same new outlook. If your wastes are discharged into a river then you ought to seek a voice in helping to develop the regulations.

The compact that established the Ohio River Valley Water Sanitation Commission recognized this principle. This compact is the expression of eight states that they pledge part of their police power to a common agency for the development of a pollution abatement program in the Ohio River Valley. These states, New York, Pennsylvania, Ohio, Indiana, Illinois, Kentucky, West Virginia, Virginia recognize that pollution can travel from state to state via interstate rivers. They also recognize that unless they controlled that pollution there would be reason for federal jurisdiction.

The compact also recognized that no single standard is applicable to the whole basin because of several factors, one of which is variety of usages of rivers. The compact called for the establishment of a board of commissioners to administer the joint program and stated that this group should counsel with industry and others concerned with clean water.

The commissioners, three from each state and three from the federal government, are the board of directors of this Ohio River Valley banking institution. You are the stockholders. The more realistic this program, the greater your dividends. Some of you and some from other industries have recognized this situation and are doing much to insure those dividends. These men are doing the work of developing the technical data needed to protect their industry from wasting money. But their proposals need the support and understanding of the entire industry if the utilization of that data is to best advantage of all.

The Steel Industry Action Committee of the Ohio River Commission is very active in defining the problems and solutions for the waste problems of their industry. The committee under the chairmanship of C. W. Weesner, consulting metallurgical engineer of Sharon Steel Corp., lists representatives from Armco, Bethlehem, Jones & Laughlin, Republic, U. S. Steel, Weirton, Wheeling, Youngstown Sheet & Tube Co., Copperweld, Pittsburgh, Empire, Crucible Steel Company of America and Allegheny Ludlum.

The original invitation of the commission to form this advisory committee was made to nine steel companies. When the feasibility and benefits of the program were apparent, these nine companies extended the invitation to some 35 other basic steel producers in the valley to join actively with them. Five accepted. Some of the others asked to be kept informed of what was going on.

Do not criticize the present pollution control programs if you think that they are unrealistic. Join them and see that they are realistic. The law that sets up pollution control agencies looks to an ideal—the protection of water courses for all to use. The language of the law is open to wide interpretation. The more views present at the council table, the more realistic the interpretation; that is, if the views presented are backed with facts and figures and not generalities.

The industry committees counseling with the commission represent steel, metal-finishing, coal, organic chemicals, brine processing, distilleries and oil refining. They are all working towards the same objective—saving you money by insuring a realistic pollution abatement program in the Ohio River Valley. Rather than curse the darkness these men are lighting candles. You can too, and thus speed the time when all can see a proper course of action. At that time pollution abatement will no longer be considered a necessary evil, but will be recognized as a way of life necessary for the betterment of all.

DISCUSSION

PRESENTED BY

CHARLES A. BISHOP, Research Associate, United States Steel Corp., Pittsburgh, Pa.

JOHN E. KINNEY, Sanitary Engineer, Ohio River Valley Water Sanitation Commission, Cincinnati, Ohio.

JOSEPH A. SAMPLE, Chief Chemist, Weirton Steel Co., Weirton, W. Va.

W. L. BARR, Chief Engineer, Follansbee Steel Corp., Follansbee, W. Va.

CHARLES C. THROOP, Superintendent, By-Product Coke Dept., Pittsburgh Steel Co., Monessen, Pa.

JOHN FERGUSON, Rice, Stokes, Ferguson, Pittsburgh, Pa.

H. M. BRIGHTMAN, Chief Engineer, Columbia Steel and Shafting Co., Carnegie, Pa.

Charles A. Bishop: A number of us from the steel industry, as he told you, have worked on this problem for the last couple of years and feel we are really getting somewhere.

I would like to ask the author if he can visualize how long we will be working on these pollution problems before we can put the whole picture together and see what we have accomplished?

John E. Kinney: Two years ago I would have said 20 years. A year ago I would have said 10 years. I do not know. There is much information available and a lot that can be done on a step by step basis that will show improvement without going to the nth degree in our answers.

There are two kinds of pollution. The first is the kind that the public can see, smell, and taste. A quart of oil will cover 70,000 square feet of water. The public will look at it and say, "There is oil pollution." But is that the really important pollution?

We have people dying from disease in cities that have no sewage treatment. But the public cannot see those bugs.

Showing accomplishments in pollution abatement is a difficult thing. But with the cooperation and impetus given by industry and by the program that they have set up, I think that within another two or three years you will begin to see some effects. In the next ten years, I do not know whether these rivers will look better—I am thinking of that oil—but in terms of cost of water treatment taking out tastes and odors, taking the solids that plug up the streams, there will be improvement.

It is like the sunrise. What time is the sunrise? You can see the sun coming up for quite a while before actual sunrise.

Joseph A. Sample: The author mentioned pure water coming out of your mountain streams. I wonder how much authority the author has to say that there might not be phenols in that stream coming from the mountain regions, which he said were pristine pure?

John E. Kinney: Mr. Sample is one of those who thought there might be taste and odor producing substances coming down the river that the steel plants were being blamed for when they should not be—phenols that came from elsewhere.

Work was done by Sharon Steel and Weirton Steel on running a survey of a mountain stream up in West Virginia to determine whether mountain streams carry phenol. They are measuring phenol in that stream.

And we have work on natural oxidation of phenol underway in the Miami River. There is a measurable phenol concentration in the Miami River above a coke plant. The waste discharged from the coke plant increases that concentration. Several miles downstream the phenol concentration is reduced to the level found above the plant. That level stays constant and is not further diminished.

W. L. Barr: We belong to the West Virginia Sewage and Industrial Waste Commission. I wonder if the author could tell us whether or not West Virginia is a part of the compact, or if they are still on the outside looking in?

John E. Kinney: The commission operates on an income from the states of $100,000 a year—based 50 per cent on the population and 50 per cent on the area in the basin. The auditor of the State of West Virginia refused to sign the voucher for West Virginia's payment of their share in this compact, which meant about $12,000. They had paid it for two years. There was a court case that was carried up to the Supreme Court of the United States with the decision of the Supreme Court that West Virginia was a member of the compact, that it was bound by the agreement and that it was their obligation to pay. The funds have been paid.

I want to pass on to you the information that some of your industry have learned that they can work with regulatory agencies, can speak very bluntly to them, can find out that every word is not being held against them, and help develop a sounding board over which problems can be worked out without anyone being led to slaughter.

This is a big program. There is a billion dollar program in the Ohio basin. That is one estimate, you can find others. If this program can be done realistically at a fraction of that cost, then the commission has justified its existence. I think it is not only your privilege, but your duty to make yourself acquainted with what this group is doing to help reduce the cost of pollution abatement.

I cannot help but remember the first time that the commission met with the representatives of the steel companies, and for a short time thereafter. I can appreciate fully, believe me, your position and the possibilities that you may have problems that you would talk off the record about but would hate to bring out in the open. It was the same kind of a setup when those companies first came together. It took a period of some eight or nine months to break that down, to learn that we could produce a healthy relationship of industry and government. They have talked over their problems together. I cannot commit the commission to anything. I cannot commit the State of Pennsylvania to anything. But I want to know what you think about this program. If you do not think it is realistic—if you think something else should be done—we want that comment. This is no sacrosanct body. The course has been changed a number of times, but the objective remains the same. If you have any comments, those that are working in this group would be most happy to have them.

A question has been asked about the industry committee participation in the toxicity study. The National Cash Register Company has undertaken for the metal-finishing industry committee the task of abstracting the literature of some 12 items. The abstracting is done on a form prepared by Kettering Laboratory that permits evaluation by qualified medical personnel.

At the same time, you have a project at Mellon Institute, doing the same kind of work, reviewing the literature, bringing it down to the point where it can be reviewed by those that are capable of doing it. That work is under the direction of these active stockholders, and Grant Howell, of U. S. Steel Co., a member of the Steel Committee, heads up that subcommittee on water quality. The work is being done at Mellon Institute under the direction of Dr. Hoak through an AISI fellowship. The information that will come out of this work at Mellon will be sent to Kettering or our Acquatic Life Advisory Committee for evaluation of its usefulness.

The following is an example of why this is necessary. Drinking water standards for interstate carriers affect only human beings. It calls for three parts per million as a limit for copper. If you can show that five times that level has no effect—even a dubious effect—is there

any reason to try and reach three as the limit on water supply?

This level for interstate carriers is picked up and used as a limit that can be found in the effluent from any plant, or the level that should be found in the stream. In some states the limiting concentration is less than 0.5 ppm. The concentration of copper in a waste can be reduced quite easily down to a cetrtain point. To reduce it further is expensive. Is it necessary? The committees want to find out if it is necessary.

Industry committee abstracting the literature cuts down the cost at Kettering. At the same time though, it gives the industry a full understanding of how much has been done in setting up recommendations.

Charles C. Throop: Mr. Kinney, have you anything to say about what method of phenol determination may eventually be accepted as standard?

John E. Kinney: Mr. Sample is doing work on analysis procedures, and last year he headed up the subcommittee on analyses.

Joseph A. Sample: About three years ago we decided that the Shaw method which had been used for 20 years or so, had served its purpose. It was obsolete and no longer good. When we came to that conclusion we decided we had to do something to supplement it or replace it. Through Grant Pettit, who was chairman of the Coke Plant Waste Committee at that time, we proceeded to do a considerable amount of work on methods, and we are at the present time hoping to get two methods placed in the next edition of Standard Methods for Industrial Waste and Sewage.

One method is what we call the DAAP analysis—distilled aminoantipyrine analysis method for effluents from plants. The other is the sensitized antipyrine method, which is a chloroform or ether extraction for color. It requires putting the sample in an electrophotometer or spectrophotometer and taking your readings off a graph or curve and getting your percentages.

We feel and believe that the sensitized methods will give you reproducibility in the range of five parts per billion. That is going to give you the concentration in your streams, not in your output from the industrial plants. We are trying to get two methods, one for industrial waste and the other for drinking water or stream use.

John E. Kinney: A question was asked about the availability of manuals. Manuals may be obtained by writing to the Ohio River Commission, 414 Walnut Street, Cincinnati, Ohio. As to the cost of the manuals, we have one on measuring flows for a dollar, the one on coke plant operations is a dollar, and then the two, one on disposal of pickle liquor and one on treatment of metal-finishing wastes, are two dollars each. The good housekeeping manual is available at no cost.

John Ferguson: We have a water plant in Dixmont, just below the Emsworth Dam, and we are very much perturbed at the present time as to how much pollution will go through, from the river bottom into our five water wells. These when they were first drilled and even yet, had samples taken which are perfectly satisfactory to the Health Board. Is there any way we can evaluate that or is there a way we can get information, particularly in connection with the fact that the new Allegheny County Authority will dump all its remaining pollution just above the Emsworth Dam, a quarter mile in front of our plant?

John E. Kinney: I think the source of information or the place for information on the effects of discharge of wastes from the proposed Allegheny County Authority sewage plant should be obtained from the State Health Department. The effect of any plant on downstream from it is part of the design considerations of the plant.

Considerable work has been recorded in the American Waterworks Journal on the percolation of pollutants in streams down through the bed of the river into aquafers. It is not within the scope of this paper, other than to say if you have a waste going downstream and it affects somebody, something should be done about it. I do not think you will find that problem at that water treatment plant is unique; I think you will find it the full length of the river. But I think one of the considerations that must be given to any waste treatment program is an understanding of the meeting point between the demand for clean water and the ability to use a stream for transmission of waste.

When it gets to the point where it costs several million dollars to put in dephenolizing equipment or methods to destroy your trace phenols through chemicals, as compared to thousands of dollars a year for water treatment in a water plant, you have reached a stage where equity calls for mutual understanding. That is part of the point that I was trying to get across in my paper. This over-all approach provides for representatives from water treatment plants who have to treat this water, representatives from the different industries that discharge the wastes and have to treat those wastes, and representatives from the groups which process the water or can evaluate the effects on aquatic life. At no time will we be able to set up a requirement to protect any one user to the detriment of the rest. The equity of the American system just does not stand for it. The compact as written up, agreed to by the eight states and sanctioned by Congress, calls for just exactly the opposite. This is an over-all community development; it goes outside the limits of any community.

H. M. Brightman: How is the U. S. Department of the Interior's work in relation to stream pollution, coordinated with the work you are doing?

John E. Kinney: We have 27 commissioners, three from each state and three from the Federal government. One is the Surgeon-General, one from the Corps of Engineers, and one from the Fish and Wildlife Service—part of the Department of the Interior. The reports of research activities carried on within those departments are available.

One of the real functions I think of this commission has been the coordinating and correlating of activities of many groups. We recognize only too well there are too many agencies doing just too many things, duplicating effort. We do not have the time or the money to waste through duplication. Our tie-in is not just a regulatory body asking for correlation, but industry demanding it. Mr. Sample referred to the recommendation of the steel committee for a method of phenol de-

termination for industrial wastes in the next edition of Standard Methods. We have steel companies demanding it. We have metal-finishing people asking for it, as well as oil refinery people needing it. They have come in and said: "This is the method we want to use since it measures our wastes." The commission has stated it will not adopt a standard without a method of determining it, and in all cases it wants scientific accuracy in doing it. That has not always been done before. Sometimes you do not have methods of measuring wastes. You talk about zero phenol in Western Pennsylvania. You do not have methods of measuring zero phenol. We now have a group that can provide methods of analysis. They go to the commission and say: "We want this method, here are the facts and figures that will prove this is better than any other method."

Do not forget, these committees are not separate from the commission, they are committees of the commission. These committees in action are the commission in action.

CURRENT AISE DISTRICT SECTION MEETING NOTICES

BIRMINGHAM SECTION

Friday, December 18, 1953

Christmas Dinner and Dance

Thomas Jefferson Hotel, Birmingham, Ala.

▲

BUFFALO SECTION

Friday, December 4, 1953, 6:30 P.M.

Christmas Dinner and Dance

Hotel Statler, Buffalo, N. Y.

▲

CHICAGO SECTION

Saturday, December 5, 1953

Christmas Dinner and Dance

Grand Ballroom, Sherman Hotel, Chicago, Ill.

▲

CLEVELAND SECTION

Saturday, December 5, 1953, 8:00 P.M.

Christmas Dinner and Dance

Rainbow Room, Hotel Carter, Cleveland, Ohio.

▲

DETROIT SECTION

Friday, December 4, 1953, 6:30 P.M.

Christmas Dinner and Dance

Main Ballroom, Detroit Yacht Club, Belle Isle, Detroit, Mich.

▲

PHILADELPHIA SECTION

Saturday, December 5, 1953—Dinner 6:00 P.M., Meeting 7:00 P.M.

"Current Hot Shearing Practice at Rotary Electric," by K. E. Lewis, Supervisor of Quality Process Control, Rotary Electric Steel Co., Detroit, Mich.

"Some Mechanical Features of Modern Bar and Rod Mills," by E. C. Peterson, Engineer, Birdsboro Steel Foundry and Machine Co., Birdsboro, Pa.

Engineers' Club, 1317 Spruce Street, Philadelphia, Pa.

▲

PITTSBURGH SECTION

Friday, December 11, 1953.

Dinner 7:30 P.M., Christmas Dance 9:30 P.M.

Hotel William Penn, Pittsburgh, Pa.

▲

YOUNGSTOWN SECTION

Christmas Dinner and Dance with Cleveland District Section—Saturday, December 5, 1953, 8:00 P.M.

Rainbow Room, Hotel Carter, Cleveland, Ohio.

FLEXIBLE CONNECTION REDUCES CRANE RUNWAY MAINTENANCE

By JAMES A. EVANS
Consulting Engineer
Massillon, Ohio

. . . . crane runways are a problem to the maintenance man both because of misalignment and because of settlement of building columns . . . .

▲IN the following, a new design for a flexible connection between the top of the crane runway girder and column will be described. This connection holds the girder in line against the column and is independent of the controversial diaphragm. Many types of connection details are in use. None of these have succeeded in completely eliminating the maintenance problem, and a great deal of discussion has been given to this subject.

Some of the methods used to eliminate these troubles seem only to make matters worse. The author has for over 20 years made inspections on such connections and as a result made recommendations for repairs. He has been able in the past three years to use strain gauges on open hearth crane runways and, as a result of these experimental tests, feels that ignorance of the forces involved and how to cope with them are the main causes for many extensive repairs. As a result of the experimental measurements, the following data on the forces involved have been obtained and these forces which the crane runways must withstand are as follows:

a. The runway girder chords change length when under loading according to Hookes law. A simple beam 83 ft 4 in. long, which is stressed with average fibre stress of 14,500 psi, will be 1 in. longer at the bottom than at the top. This distortion is directly proportional to the span length and also directly proportional to the fibre stress.

Difference in length between top and bottom flanges

$$\frac{2 \times \text{average stress (psi)} \times \text{length (in.)}}{\text{E (modulus of elasticity)}}$$

$$\text{or } \frac{2 \times 14{,}500 \times 1{,}000}{29{,}000{,}000} = 1 \text{ in.}$$

b. Horizontal thrust in either direction at top of runway rail due to cross travel of crane trolley.

c. Change in length due to temperature. It must be remembered that this does not affect the center to center distance between building column piers, but amounts to 1 in. in 128 ft for a 100 degree F change, lengthwise and crosswise in the upper building.

d. Uneven column settlement due to varying soil bearing properties, because the crane does more work at certain points in the building, column pier shift and other reasons.

Some of these forces take place only part of the time. The following outlines frequency of such force application:

a. Runway girder chords change length every time the girder is loaded.

b. Horizontal thrust takes place whenever the trolley is moved on its track.

c. Changes in temperature may be seasonal.

d. Uneven column settlement is gradual throughout the years.

Loadings caused by temperature changes and column settlement introduces residual stresses at the ends

which may be aggravated by the constantly applied force due to changes in the runway girder chord lengths, and those due to trolley travel.

Continuous girders are rarely, if ever, used in crane runways because of possibilities of column settlement. Whatever degree of continuity is originally built into the connection cannot be relied upon because of this uneven column settlement. After being in service a few years, a checkup of column elevation will show some columns high and some low. A change of ¾ in. in 20 ft

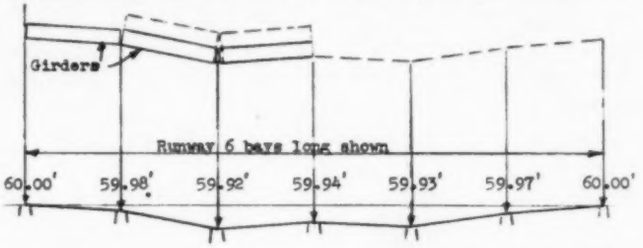


Figure 1 — Typical pattern for column and runway settlement is illustrated here. End columns usually do not settle as much as the interior columns.

may not be serious for a simple beam but would be disasterous for a continuous one. A change of 2 in. in 20 ft is not uncommon.

Figure 1 is exaggerated to show what happens when the column is high or when the column is low. A deeper

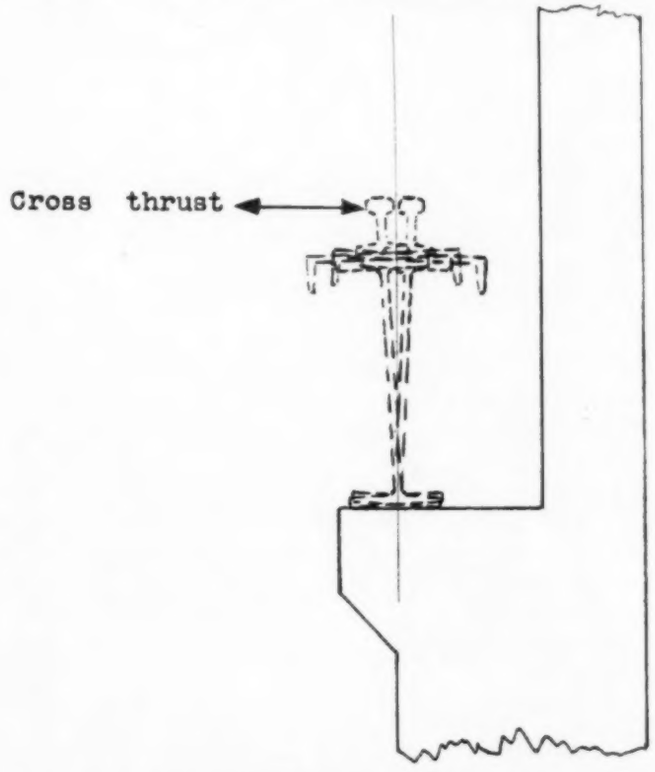


Figure 2 — This exaggerated view shows the rocking action of the girder which takes place when the crosswise connection is loose.

girder aggravates this as indicated by the dotted lines. This figure also shows a typical elevation checkup graph after several years of service. Note that the end columns are high since these columns take only a partial roof and crane column load.

Figure 2 shows (exaggerated) that when the connection is lose, the cross thrust rocks the girder and has a twisting action which accounts for the higher number of loose rivets near the ends.

The trolley and crane cross thrust is applied at the top of the runway rail, and should be taken into the column at or near this elevation, since the girder heels or pivots about the base. Therefore, this thrust is doubled if taken halfway down, etc.

A very common failure is a cracked web just above

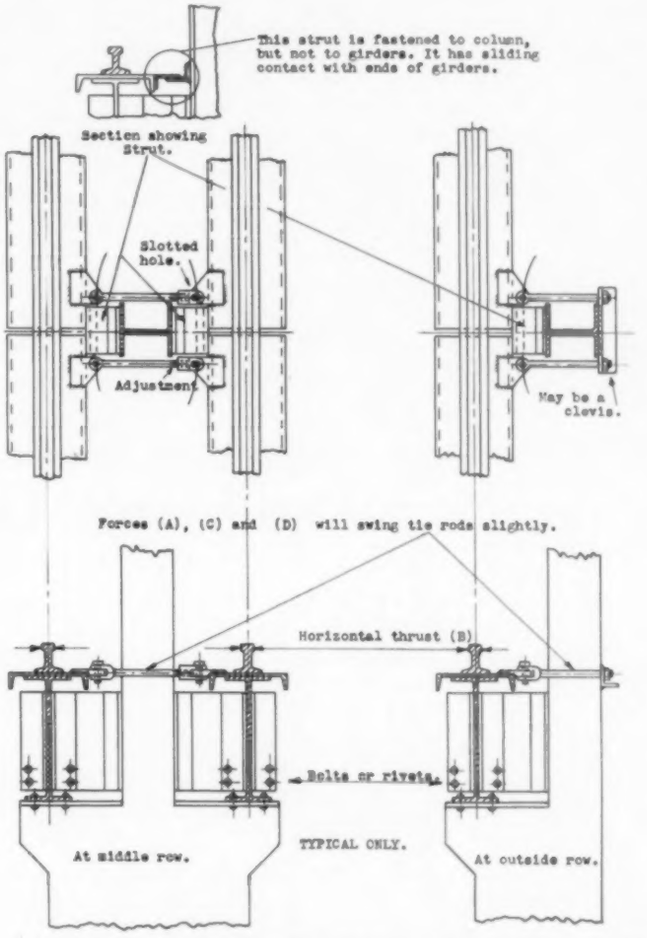

This strut is fastened to column, but not to girders. It has sliding contact with ends of girders.
Section showing Strut.
Slotted hole.
Adjustment
May be a clevis.
Forces (A), (C) and (D) will swing tie rods slightly.
Horizontal thrust (B)
Bolts or rivets
At middle row.
TYPICAL ONLY.
At outside row.

Figure 3 — The new flexible connection replaces or relieves the diaphragm. It is easy to install both in a new or existing building.

the diaphragm. Here the increased thrust repeatedly bends and finally breaks the web.

The new design which is described in Figure 3 allows for Hookes law, holds the girder the proper distance from the column and takes the cross thrust at the top flange, thereby protecting the web, and it does this without regard to the type of diaphragm.

In most existing designs, after a few years the connection is loose and, in tearing itself loose, is damaged with the girder. The new design is loose and free from the start. There is no twisting or buckling action. Stresses are primary tension in the rods and compression in the struts. It follows that a lighter girder can be safely used with this design, since the ends will be free from high residual stresses.

In an existing building, it helps protect the diaphragms as it keeps the girders in line against the column.

This flexible design provides a small expansion joint at every column. It holds the girder the correct distance from the column top shaft at all times. It makes the style of diaphragm a secondary matter, and can be used with no diaphragm, the usual single (which the writer prefers) or a double diaphragm. This means, of course, that in an existing building the diaphragms need not be changed.

A bad condition is due usually to poor design. The usual excuse for the bad condition at the connection is that the runway is overloaded. The writer has checked hundreds of runways (adding 25 per cent impact and using the worst possible loading condition) and found only a few with stresses over 20,000 psi.

Bridge designers allow for about 130 F temperature change longitudinally (1 in. in 100 ft) by means of rockers, rollers, etc., and this allows for Hookes law also.

Construction men and erectors know from experience that building onto the end of a long building in hot weather proves that temperature does make the ends lean outward. This expanding or lengthening causes the knee braces to lift the girders; so there should be a diaphragm to hold the girder down. As the building cools and shortens, there must be a good tie at or near the girder bottom or the building will remain partly extended.

The old offside connection soon gets loose, and looser as the years go by. It is usually not tightened up until it becomes dangerous. Then the cycle is gone over again. Shear and stress increments are higher at the girder ends, and loose rivets here lead to higher stresses and more loose rivets and breaks.

In this discussion, it is assumed that the girders are seated.

Some runways are used so infrequently, and the stress number of cycles factor is so low that present designs have reasonable life. However, who can anticipate the service conditions of a runway, except possibly a motor room.

This design will require less attention and repair. These repairs come unusually high, since the repair is generally done while the department is operating. Thus much time is lost in delays and extra men are required to do the job safely and quickly. Elimination of such repairs will reduce maintenance costs.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC. OF

IRON AND STEEL ENGINEER

(Required by the Acts of Congress of August 24, 1912, March 3, 1933 and July 2, 1946)

Name of Publication: *Iron and Steel Engineer*, published monthly at Pittsburgh Pennsylvania. (Report of October 1, 1953.)

State of Pennsylvania

County of Allegheny

Before me, a notary public in and for the State and county aforesaid, personally appeared T. J. Ess, who, having been duly sworn according to law, deposes and says that he is the editor of the *Iron and Steel Engineer* and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Acts of March 3, 1933 and July 2, 1946, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher: Association of Iron and Steel Engineers, 1010 Empire Building, Pittsburgh, Pennsylvania.

Editor: T. J. Ess, 1010 Empire Building, Pittsburgh, Pennsylvania.

Managing Editor: None.

Business Manager: None.

2. That the owner is: Association of Iron and Steel Engineers, 1010 Empire Building, Pittsburgh, Pennsylvania.

No stockholders.

BOARD OF DIRECTORS

1953

President, JOHN L. YOUNG, *Vice President—Engineering*, United States Steel Corp., Pittsburgh, Pa.

First Vice President, E. L. ANDERSON, *Superintendent Electrical Dept.*, Bethlehem Steel Co., Johnstown, Pa.

Second Vice President, JOHN H. VOHR, *General Superintendent*, Gary Works, United States Steel Corp., Gary, Ind.

Treasurer, W. H. COLLISON, *Assistant General Superintendent*, Blast Furnace Div., Great Lakes Steel Corp., Ecorse, Mich.

Secretary, J. D. O'ROARK, *Assistant Manager, Service and Maintenance*, Weirton Steel Co., Weirton, W. Va.

Past Presidents: A. S. GLOSSBRENNER, *Vice President Operations*, Youngstown Sheet & Tube Co., Youngstown, Ohio.

I. N. TULL, *Electrical Superintendent*, Republic Steel Corp., Cleveland, Ohio.

Honorary Directors: JAMES FARRINGTON, *Special Assistant to Chief Plant Engineer*, Wheeling Steel Corp., Steubenville, Ohio.

C. L. MCGRANAHAN, *Technical Assistant to Works Manager*, Sollac, Seremange (Moselle) France.

L. F. COFFIN, *Assistant General Manager*, Bethlehem Steel Co., Sparrows Point, Md.

Director-at-Large: L. LARSON, *Chief Engineer*, Republic Steel Corp., Cleveland, Ohio.

Directors: C. G. MARSHALL, *Superintendent of Construction, Engineering*—Raw Materials Division, Tennessee Coal and Iron Div., United States Steel Corp., Fairfield, Ala.

A. M. CAMERON, *Superintendent Rolling Mills*, Atlas Steels Limited, Welland Ontario, Canada.

F. A. JOHANTGEN, *Electrical Engineer*, International Harvester Co., Wisconsin Steel Works, Chicago, Ill.

W. W. BENTZ, *Superintendent Maintenance*, McDonald and Upper Works, United States Steel Corp., McDonald, Ohio.

ROBERT SERGESON, *Chief Metallurgical Engineer*, Rotary Electric Steel Co., Detroit, Mich.

J. S. MORRIS, *Supervisor of Construction*, Lukens Steel Co., Coatesville, Pa.

EMIL KERN, *Vice President in Charge of Engineering*, Allegheny Ludlum Steel Corp., Brackenridge, Pa.

L. V. BLACK, *Superintendent Electric Dept.*, Bethlehem Steel Co., Bethlehem, Pa.

E. T. W. BAILEY, *Chief Combustion Engineer*, The Steel Co. of Canada, Ltd., Hamilton, Ontario, Canada.

T. M. FAIRCHILD, *Superintendent*, Franklin Mills, Bethlehem Steel Co., Johnstown, Pa.

D. W. LLOYD, *General Superintendent*, Brier Hill Works, Youngstown Sheet and Tube Co., Youngstown, Ohio.

F. E. ROBINSON, *Assistant Division Engineer*, American Steel and Wire Div., United States Steel Corp., Cleveland, Ohio.

R. A. KRAUS, *Assistant Maintenance Superintendent*, Republic Steel Corp., Chicago, Ill.

3. That the known bondholders, mortgages, and other security holders owning or bolding 1 per cent or more of total amount of bonds, mortgages or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

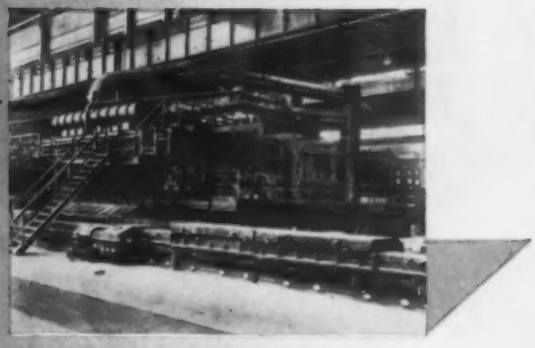
T. J. ESS, Editor,

Sworn to and subscribed before me this 8th day of October, 1953.

ALMA A. JORDAN, Notary Public

(My commission expires January 2, 1955.)

LOOK TO RUST FOR FURNACE EFFICIENCY



METAL INDUSTRIES RELY ON *Rust furnaces* FOR GREATER OUTPUT AND PROVEN ECONOMY IN ALL PHASES OF METALLURGICAL HEATING

Whether it's an OPEN HEARTH FURNACE, SOAKING PIT, SLAB HEATING, ROTARY HEARTH, FORGING, CAR BOTTOM, ANNEALING or any other type of metallurgical furnace, you can rely on Rust's half-century of engineering know-how and furnace experience for top performance. Ask the men who operate Rust furnaces (all fuels) . . . They all say: "efficient . . economical . . automatic . . easy to operate . . trouble free . ." Whatever your need, be it either a new furnace or a modernization of existing facilities, look to Rust for the complete job.

THE WHOLE JOB IS ONE JOB WITH A

RUST "PACKAGE" CONTRACT

One contract covers everything . . . from blueprint through start up. Rust assumes responsibility for design, manufacture, erection, and is prepared to undertake all phases of the work with its own forces, including wiring and piping. This results in substantial savings . . . One profit instead of pyramiding ones which accrue where many subs are employed.

RUST FURNACE COMPANY

Pioneers in Furnace Design

RUST BUILDING PITTSBURGH, PA.

MERRILL J. BOOTH
BIRMINGHAM DISTRICT SECTION

T. V. EPPERT
BUFFALO DISTRICT SECTION

ROBERT E. DU BOIS
CHICAGO DISTRICT SECTION

AISE DISTRICT SECRETARIES

W. W. SPANAGEL
CLEVELAND DISTRICT SECTION

O. P. ASHURST
DETROIT DISTRICT SECTION

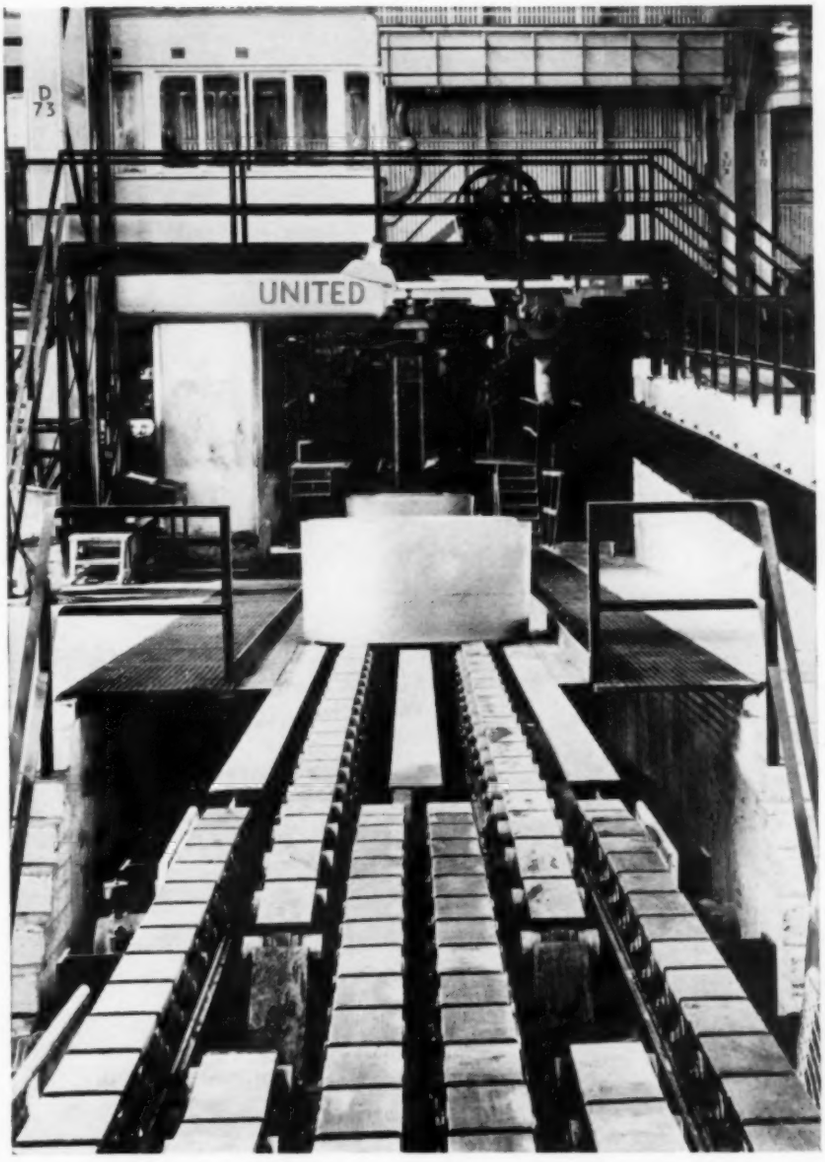
1953 - 1954

LINN O. MORROW
PHILADELPHIA DISTRICT SECTION

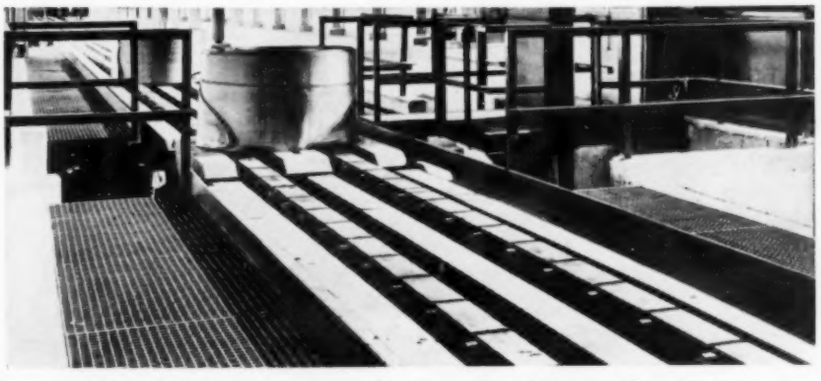
J. S. MURRAY
PITTSBURGH DISTRICT SECTION

JAY F. HALL
YOUNGSTOWN DISTRICT SECTION

Newest British continuous strip mill moves coils on LINK-BELT conveyors



Transfer point on Link-Belt double-strand roller chain conveyor from the coiler. Up to 30,000-lb. coils are cooled as they move to storage.



Coils are lifted from conveyor for automatic weight recording. Entire system is synchronized and under full control of pulpit operators.

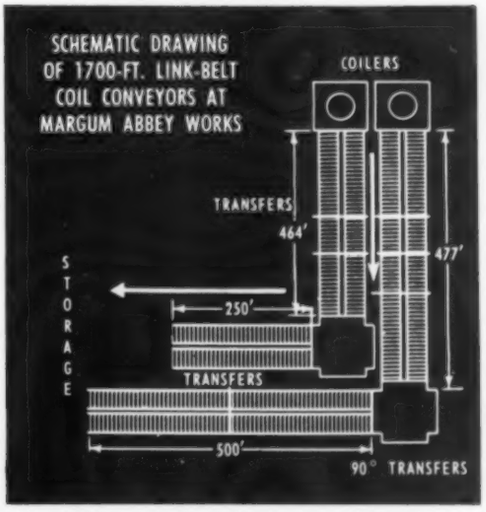
Up to 30,000-lb. coils are carried safely, gently from coilers to storage

RANKING in efficiency with the most modern mills is the new Margum Abbey Works of the Steel Company of Wales on Swansea Bay. To build it, four principal British steel producing companies pooled their resources.

For transporting coils from the coilers to storage, Link-Belt furnished conveying, weighing and transfer equipment through United Engineering & Foundry Co., Pittsburgh. As can be seen from the diagram below, movement is accomplished without the use of overhead cranes or lift trucks. This means not only greater capacity but also improved safety.

What's more, gentle handling increases yield. Waste goes down because there's no scuffing of edges, no telescoping of coils.

Link-Belt builds coil handling conveyors to meet widely varying physical and economic requirements. Our engineers will work with your own engineers, consultants and builders of mill and process equipment — help you select the right system for your exact needs.



LINK-BELT

MATERIALS HANDLING, PROCESSING & POWER TRANSMISSION EQUIPMENT

LINK-BELT COMPANY: Plants: Chicago, Indianapolis, Philadelphia, Colmar, Pa., Atlanta, Houston, Minneapolis, San Francisco, Los Angeles, Seattle; Scarboro, Toronto and Elmira, Ont. (Canada); Springs (South Africa); Sydney (Australia). Sales Offices in Principal Cities.

13 318

4-HIGH 6-STAND CONTINUOUS HOT STRIP MILL

(OPERATING IN WALES)

DESIGNED AND BUILT BY

UNITED

ENGINEERING AND FOUNDRY COMPANY

PITTSBURGH, PENNSYLVANIA

UNITED can serve you no matter where in the world you are.

Plants at: PITTSBURGH • VANDERGRIFT • NEW CASTLE • YOUNGSTOWN • CANTON

Subsidiaries: ADAMSON UNITED COMPANY, AKRON, OHIO • LOBDELL UNITED COMPANY, WILMINGTON, DELAWARE • STEDMAN FOUNDRY AND MACHINE CO., INC., AURORA, INDIANA

Designers and Builders of Ferrous and Nonferrous Rolling Mills, Mill Rolls, Auxiliary Mill and Processing Equipment, Presses and other Heavy Machinery Manufacturers of Iron, Nodular Iron and Steel Castings, and Weldments.

Expansion

at the

STEEL COMPANY OF WALES

by T. J. Ess

....for data for this description of the huge expansion program, the author is indebted to S. E. Graeff, director of the Steel Co. of Wales, Limited, and Richard Thomas & Baldwins, Limited, and also to Alastair McLeod, managing editor of Iron and Coal Trades Review, which published an excellent technical survey of the new facilities....

▲ THE area surrounding Port Talbot, Wales, has been associated with the production of iron and steel for centuries, records showing that the monks of Margam Abbey engaged in mining iron ore at Cornelly as far back as 1253. The present Port Talbot works was first laid down in 1901 and the adjoining Margam works was started in 1916.

In March, 1947, The Steel Co. of Wales announced a large expansion program in connection with the existing plants. This project included an 80-in. continuous hot strip mill with attendant finishing equipment, and required the construction of a new open hearth shop, a new slabbing mill, new blast furnaces, new coke ovens, a new by-product plant, and a new coal washery, modernization of the two existing melt shops, enlargement of an existing limestone quarry, and the expansion of various auxiliaries. Construction on the new project began in April, 1947. This project is now virtually completed and, with modern facilities of excellent design, rivals similar installations anywhere in the industry.

As the foregoing program neared completion, additional expansion, to cost about $120,000,000, was announced. This program includes the following major items:

Margam Works

Ninety new coke ovens (9000 tons of coke per week).
A new by-product plant.
Improvement in gas distribution systems.
One new blast furnace, 29-ft hearth (10,000 tons per week).
Extension of the ore unloading wharf.
Expansion of facilities for sintering, steam generation, lime burning, gas cleaning, etc.

Abbey Works

Four new 225-ton open hearth furnaces.
One new 800-ton mixer.
Four new soaking pits.
Continuous scarfing machine at slabbing mill.
One additional slab heating furnace for the strip mill.
Two new continuous pickling lines.
Four more portable cover annealing furnaces for coils.
Expanded facilities for finishing plates and hot rolled sheet.
Addition of various auxiliaries, such as cranes, diesel-electric locomotives, etc.

Velindre Works

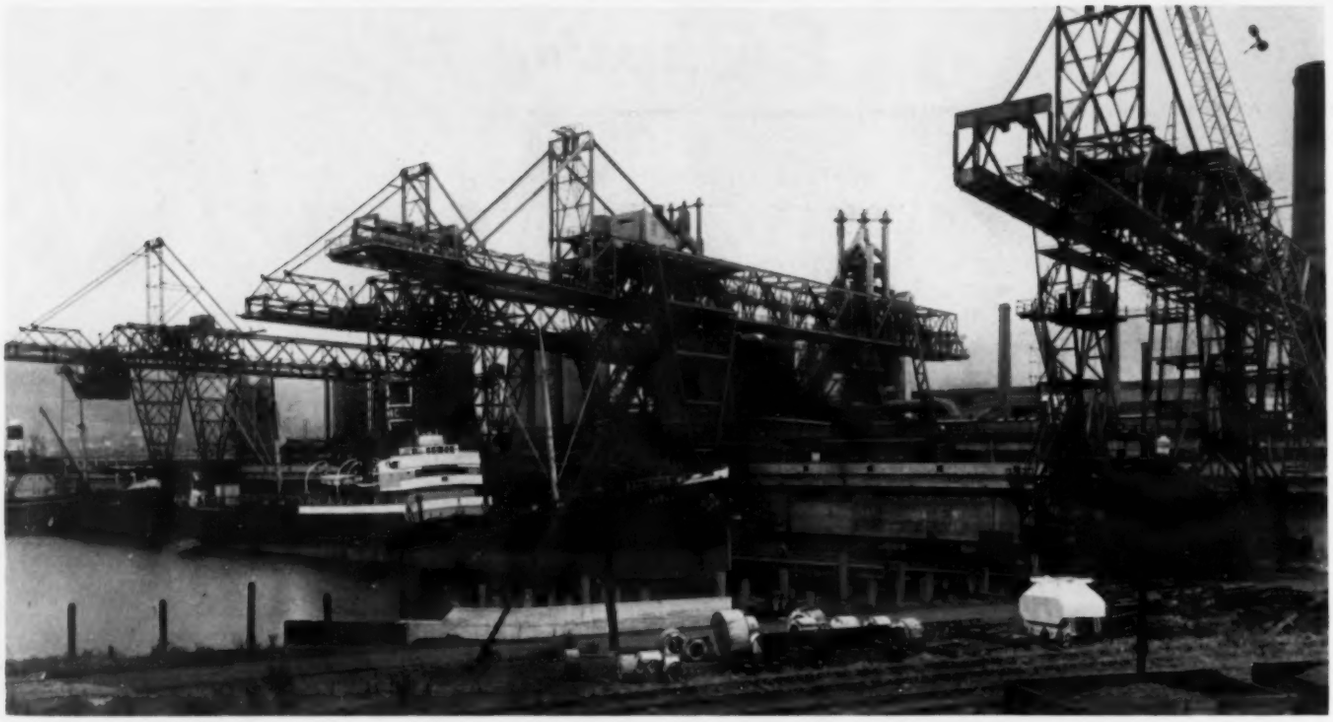
This is a new plant located near Llangyfelach, near Swansea, designed to process 30,000-lb pickled coils from Abbey works into finished sheared black plate. It will include a five-stand, 42-in., tandem, cold reduction mill, two electrolytic cleaning lines, annealing furnaces, two two-stand 42-in. temper mills, four shearing lines. Space is also provided for the future installation of electrolytic or hot-dip tinning facilities if desired.

Work has begun on many of these new items, but unfortunately, data is not available to permit their coverage in the following discussion.

RAW MATERIALS

Foreign ores supply the major portion of the blast furnace requirements, and to take care of the varying

This new coal washer can process 350 tons of coal per hour. It contains two wash boxes in parallel.



An ore yard of 500,000 tons capacity lies between the dock line and the row of three modern blast furnaces.

supply, ore preparation facilities were installed. A crushing plant, designed for 1000 tons per hr, can handle lumps up to a two-foot cube, breaking them down to a maximum size of 3 to 4 in., or down to 1½ in., if desired. Crushing is accomplished in two stages, with two gyratory crushers in the primary stage, and two cone type crushers in the secondary stage. They are fed by two independent 48-in. belt conveyor systems. Vibrating screens ahead of each stage of crushing remove undersized material, which is subsequently mixed back into the crushed material.

Crushed ore from the secondary crushers is carried on two 48-in. belts to a screen house, where two sets of four vibrating screens remove all ore smaller than ⅜ in. This fine ore is carried on a 48-in. conveyor belt direct to the sinter plant bunkers or stockyard. The ore over ⅜ in. is similarly conveyed to a conveyor house at one end of the furnace high-line and then distributed to the furnace stock bins by 50-ton transfer cars.

The sintering plant is designed to produce 2000 tons of sinter per day from foreign ore concentrates, screenings of raw ore cargoes, all furnace flue dust and some fine mill scale. The sintering machine is a continuous strand unit 8 ft 3 in. wide, with 19 wind boxes affording a grate area of 970 sq ft. A suction fan to handle 245,000 cfm at 40 in. water column and 300 F is driven by a 2650-hp motor through a hydraulic coupling that gives a speed regulation of 25–90 per cent. The ignition hood is fired with blast furnace gas. In the sintering plant, materials are handled by a series of stock bins, conveyor belts, mixers and feeders typical of the most modern installations.

Finished sinter discharged from the machine is broken by a spiked roll breaker and passes on to a cooler consisting of a continuous metal conveyor which carries the sinter in louvred pans which allow cooling air to pass through. The whole conveyor is enclosed to form a duct through which air is drawn by three suction fans. At full production, sinter temperature is reduced to about 210 F.

Cooled sinter is delivered to a vibrating screen, where everything over 1 in. is removed and carried on a conveyor belt to the conveyor house at the blast furnace high line. Here 50-ton transfer cars distribute it to the blast furnace bins. The minus-1 in. sinter is returned to the sinter plant bins for reprocessing.

Limestone is obtained from Cornelly quarry, which contains hard carboniferous limestone in beds varying from 2 to 12 feet. The stone is excellent for use in blast furnaces and open hearths, containing 55 per cent CaO, 1 per cent SiO_2 and 0.5 per cent Al_2O_3. The quarry has been completely mechanized.

Materials arriving by rail, such as native ores, limestone, etc., are handled by a car dumper into a hopper, from where a pan feeder moves it on to a 48-in. conveyor belt leading to the conveyor house at the blast furnace high line. Limestone may be diverted from the conveyor to a lime-burning plant as desired.

Coking coal comes by rail from mines located in the Garw, Llynfi, Ogmore, Afan, Duffryn and Rhondda valleys, all of which are in the neighborhood. Two car dumpers discharge the coal from the cars onto two 42-in. conveyor belts which carry it to a new coal washery. Here the incoming coal is fed to two wash boxes in parallel, each of 175 tons per hr capacity. The coal is then passed over four sets of reciprocating screens for water and slurry removal. The dewatered coal is then delivered by chutes and conveyor belts to any of thirty 200-ton reinforced concrete bins for draining and storage. Coal can be drawn at carefully regulated rates from any bin onto conveyor belts, effectively blending coals from various bins as desired. A conveyor belt then moves the washed, blended coal to a crusher house where three hammer mills are installed. After crushing, another conveyor carries the coal to the bunkers of the coke ovens.

COKE PLANT

To provide additional coke for the expansion, the original coke plant, built in 1939, was enlarged from a capacity of 1000 tons of coal per day to 2500 tons per day. The original battery consisted of 54 ovens. The addition provides 90 ovens, 17¾ in. wide with a 2½-in. taper, 12 ft 6 in. high, and 44 ft 7½ in. long, taking a wet coal charge of 16.15 tons per oven. They are built in six blocks of 15 ovens each.

The ovens may be heated with coke oven gas through underjet burners or with blast furnace gas through pipes and nozzles leading to individual compartments of the regenerators. Air is supplied to the battery at the generator inlets under natural draft, but provisions are made to supply air under pressure if desired.

Oven doors are of self-sealing type. At present there is only one ascension pipe per oven, but collecting mains are designed to permit future installation of duplicate ascension pipes and cross-over mains.

Two sets of machines are provided, each consisting of a combined ram, leveler and door machine, a coke-side door machine with trailing coke guide, a quenching car and locomotive and a charging larry. A new quenching station was added, which, with an existing station, handles the output from all ovens.

Coke from a new 280-ft wharf is conveyed to a new screening station where all coke over 4½ in. is crushed and vibrating screens separate the sizes. All coke above 1¼ in. goes to the furnace conveyor or to a boom loader, while ⅞-1¼ in. coke goes either to the furnace conveyor or to the domestic screens where it joins the coke under

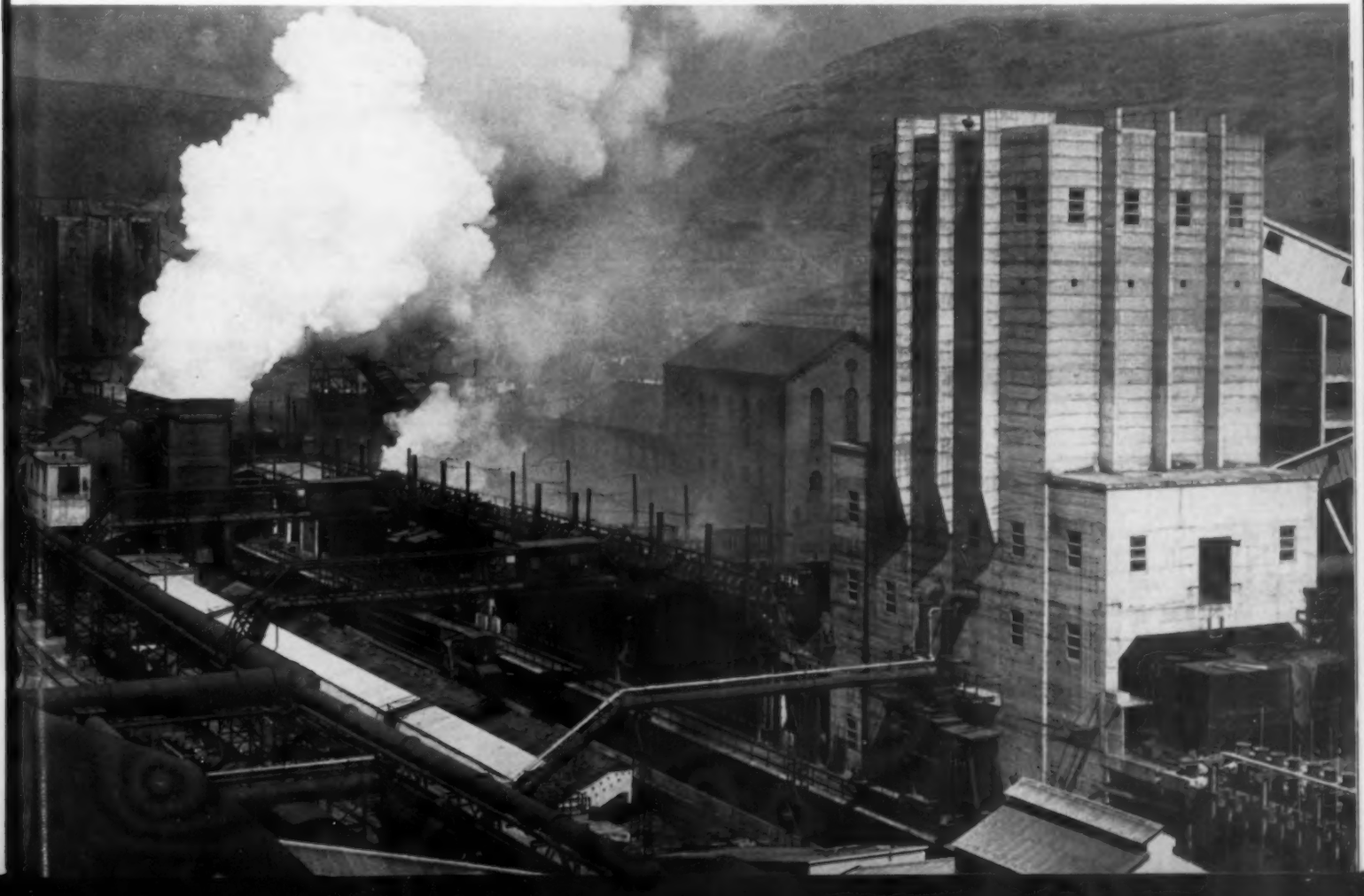
A web of conveyors serving the coke plant provides efficient handling for both coal and coke.

⅞ in. Vibrating domestic screens divide the small coke into grades suitable for the domestic market.

A new by-product plant was constructed to replace the old semi-direct plant. It will handle the gas from 2750 tons of coal per day. There are six primary coolers of vertical water-tube type, followed by two turbo-exhausters of 1,375,000 cfhr capacity each. The exhausters deliver to five electro-detarrers where final traces of tar are removed before the gas enters one of two monel metal saturators. Ammonium sulphate is centrifuged, dried and bagged.

Following the saturators in the gas stream are two secondary coolers, 14 ft in diameter and 118 ft high,

Margam coke plant, with 194 ovens, can coke 2500 tons of coal per day.



The three blast furnaces have revolving distributor tops and are designed with single downcomers.

the second having a naphthalene extraction section wherein gas is washed with warm benzolized oil before final cooling prior to benzol removal. There are four benzol scrubbers in series, 15 ft in diameter × 102 ft high and packed with wooden grids. Two stripping stills, each of 7000 gphr capacity, produce crude benzol for immediate disposal, no refining being carried out. Naphthalene is washed out of the debenzolized gas in two parallel scrubbers.

Booster capacity is sufficient for the total gas production of 32,800,000 cu ft per day, and the gas may be pumped to Margam or Abbey works or to the mains of the public gas supply.

BLAST FURNACES

Three blast furnaces designed for an output of 19,000 tons per week were built on the site of three small furnaces. The furnaces are situated along the Port Talbot dock, which is 950 ft long and parallels the furnace line. The entrance lock, however, limits the size of ships to about 425 ft long, with cargoes of about 8000 tons. Between the dock and the furnaces is an ore yard, 1350 ft × 150 ft, which accommodates 300,000-500,000 tons of iron ore. Three new 12½-ton unloader bridges, spanning the ship, stockyard and furnace bins, supplement two old smaller bridges in handling ore from the ships to the stockyard or bins, or from stockyard to bins. The new cranes can each handle 500 tons of ore per hour, and operate under adjustable voltage control. Three electrically operated, side-dump 100-ton transfer cars running along the dock side of the ore yard and four bottom-dump 50-ton cars on the furnace high line round out the ore handling equipment. The 100-ton cars are also used to feed the ore crushing plant or to handle sized ore and concentrates carried by the conveyor belts from the sintering plant and from the ore crushing plant.

The furnaces are served by a common high line running over 39 reinforced concrete bins. The bins hold 700 tons of coke, 1500 tons of limestone, and 20,000 tons of ore, sinter, etc. All bins with the exception of those for coke, have double lip bin gates, operated by pneumatic lifting jacks on the scale cars. The high line tracks, which total 1475 ft in length, extend 280 ft beyond the bins at one end to the conveyor station and 390 ft at the other end to serve the stockyard and unloading bridges.

Coke from the coke bins is screened to remove all minus ⅞-in. material, and then passes into weigh hoppers and finally is dumped into the skip cars.

Four double-hopper scale cars (one of 160-cu ft capacity per hopper, three of 220-cu ft per hopper) serve the three furnaces. All cars are fitted with dial indicator scales. The cars are driven by 40-hp motors and are fitted with air compressors for operating bin gates, scale car hopper doors, and brakes.

Principal dimensions of the blast furnaces are given in Table I.

No. 1 furnace has a mild steel hearth jacket with riveted butt straps, joined to the tuyere belt by a welded apron. The hearth jacket is cooled by external sprays. The hearth is constructed of 9 ft of refractory concrete and 12 ft of 42 per cent alumina brick on top of the regular concrete foundation. Hearth walls are built of the same quality of brick. Between the brickwork and the hearth jacket, a space of 10 in. is rammed with a mixture of coke and tar. Two slag notches are provided, at 51½ and 206 deg, respectively, to the tap hole.

No. 2 furnace has a welded steel hearth jacket, cooled by conventional stave coolers. A carbon hearth is installed, consisting of carbon walls carried up to the bottom row of tuyere coolers, and 4 ft 6 in. of carbon in the hearth (two layers, each of 2 ft 3 in.). Below the carbon is a depth of 9 ft of brickwork and 9 ft of refractory concrete. Slag notches are at 45 and 135 deg angles to the iron notch.

No. 3 furnace hearth duplicates that of No. 2 except that refractory brickwork replaces the carbon bottom and the carbon walls are extended down to the stave coolers.

All three furnaces are similar in construction above the tuyeres. The tuyere belt is of mild steel and the bosh is banded to the mantle. Shells are steel plated to

TABLE I

	No. 1	Nos. 2 and 3
Diameter of hearth, ft-in.	21-6	25-9
Diameter of bosh, ft-in.	25-0	28-9
Diameter of stockline, ft-in.	17-9	20-0
Diameter of large bell, ft-in.	13-0	15-0
Diameter of small bell, ft-in.	6-0¾	6-6
Angle of big bell, deg	52	52
Height of crucible, ft-in.	10-3	11-9
Height of bosh, ft-in.	10-6	10-0
Height of straight section, ft-in.	10-0	9-6
Height of inwall section, ft-in.	44-0	54-8¾
Height of stockline section, ft-in.	7-6	6-0¾
Height, iron notch to top ring, ft-in.	93-0	104-0
Height, tuyeres to stockline, ft-in.	73-6	82-0
Height, bottom to iron notch, ft-in.	1-6	2-6
Height, iron notch to cinder notch, ft-in.	4-0	4-6
Height, cinder notch to tuyeres, ft-in.	3-3	3-6
Bosh angle, deg-min.	80-52	81-2
Inwall batter, in. per ft	.989	.956
Working volume (tuyeres to stockline), cu ft	27,716	40,615
No. of tuyeres	14	16
No. of columns	7	8
No. of hot blast stoves	4	3
Height of stoves, ft-in.	96-0	110-0
Diameter of stoves, ft-in.	21-0	26-0
Heating surface per stove, sq ft	126,000	197,000
Capacity, gross tons per day	700	1,000

the top. Cooling in the tuyere jacket, bosh and stack is by means of flat copper coolers built into the brickwork. Stockline protection consists of mild steel plates bent at right angles and built into the brickwork. Furnace tops are of the conventional revolving distributor design.

There are four offtakes on each furnace which combine into a common downcomer leading to a primary dustcatcher. Gas then goes to a whirler and then to a common crude gas main before passing to the gas cleaning plant, which consists of eight electrical precipitator units, each rated at 2,000,000 cfm and each preceded by a scrubber tower 107 ft high × 14 ft in diameter.

Effluent from the scrubbers and precipitators is clarified in two thickeners. Clean gas is distributed through the three plants and is used at coke ovens, blast furnace stoves, boilers, lime plant, mixers and reheating furnaces.

Blowing equipment for the furnaces consists of three steam-driven turbo-blowers, one rated at 60,000 cfm and two at 80,000 cfm. Steam is supplied from a new boiler plant operating at 625 psi, 800 F. An existing 46,000 cfm turbo-blower was retained as a spare. Connections to cold blast mains are arranged to make the blowers interchangeable.

Two double strand pig casting machines are installed.

OPEN HEARTH

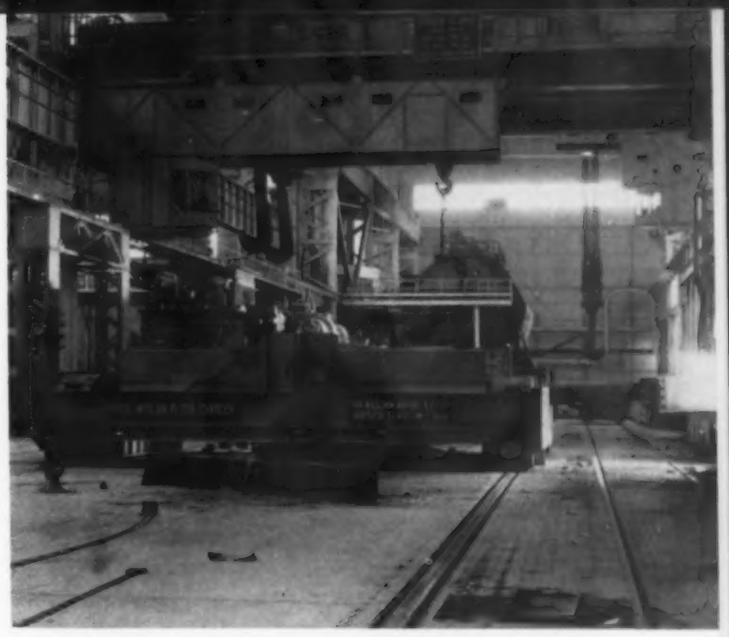
Three open hearth shops comprise the steelmaking facilities, of which the Port Talbot shop is the oldest, beginning operations early in 1914. The need for steel during World War I led to the construction of the Margam plant, which went into operation in 1918. The new Abbey open hearth shop, which is the largest, went into operation in April, 1951.

These three shops produce ingots for the new Abbey slabbing mill, which requires more than 40,000 tons of ingots per week.

Originally, the Port Talbot shop contained six 60-ton furnaces. All of these have been reconstructed as 80-ton units, and the other two are being rebuilt. The new design, which has been adopted as standard for both Port Talbot and Margam shops, has principal dimensions as shown in the first column of Table II.

The Port Talbot furnaces are fired with fuel oil, and each is equipped with a fire-tube waste heat boiler. The

This view of the open hearth shop shows the unusual design used for all of the buildings at Abbey.



Shown here on the open hearth charging floor are one of the charging machines, a hot metal ladle and, in the background, the hot metal mixers and mixer crane.

furnaces are charged by three 3-ton overhead charging machines. Hot metal is brought from the Margam mixer to the casting bay in 65-ton ladles, which deliver the hot metal to the furnaces by means of chutes in the back wall. Two 100-ton ladle cranes are being replaced by 135-ton cranes, which will permit heats to be enlarged to about 100 tons. Charges average about 50 per cent hot metal and a wide range of grades of steel are produced. Big-end-down slab ingots, 10-20 tons in weight, are poured on buggies.

The Margam shop initially contained four 60-ton furnaces, and was later increased to six. Five of the furnaces have been completely rebuilt in accordance with the design previously mentioned, while the other one has been modified in accordance with dimensions given in the second column of Table II.

The fuel used at Margam is tar-pitch-creosote with coke oven gas. Four waste heat boilers are installed and it is planned to equip all six furnaces eventually.

Hot metal from the blast furnaces comes to a 400-ton mixer at one end of the Margam shop in 80-ton ladles and is re-poured into 40-ton ladles which can be picked up by a 60-ton hot metal crane. This crane operates on the same runway as three 5-ton overhead charging machines. Here again, two 100-ton ladle cranes are being replaced by 135-ton cranes, which will permit the production of 100-ton heats.

Charges for the Margam furnaces contain about 50 per cent hot metal. Output of the shop is all low-carbon deep-drawing steel. All ingots are poured on buggies.

The Abbey melt shop, built on a new site about one mile from the Margam plant, contains eight 200-ton stationary basic open hearth furnaces, with provisions for increasing the number to twelve. The furnaces, built on 108-ft centers, have dimensions as shown in the third column of Table II. The main roof is straight, with no knuckle, but a slight ramp at each end. Back walls are fully sloping. Front wall and back wall provide a slight constriction at the throats. At each end two uptakes rise from a large slag pocket. Between uptakes is a doghouse with flat water-cooled roof.

Archless door frames are tapered on No. 1, 2, 4 and 5

doors, being 3 ft 3 in. wide at the bottom, 4 ft 6 in. wide at the top, and 4 ft 6½ in. high. The middle door is straight, 4 ft 6 in. × 4 ft 6½ in. Under the middle door is a slagging hole through which slag runs into a 400-cu ft slag pot which runs beneath the furnace between the slag pockets and regenerators.

Front and back walls are of basic brick, as are the doghouses and the wing walls. Uptakes are bricked in silica. The main roofs are 15 in. thick with 18-in. ribs, and a 3-ft wide drop section, 18 in. thick with 21-in. ribs, extends along the back skewbacks. Slag pocket arches and walls are of silica brick. Regenerator arches and walls are of first quality firebrick. Slag pocket and regenerator areas are insulated with vermiculite plaster.

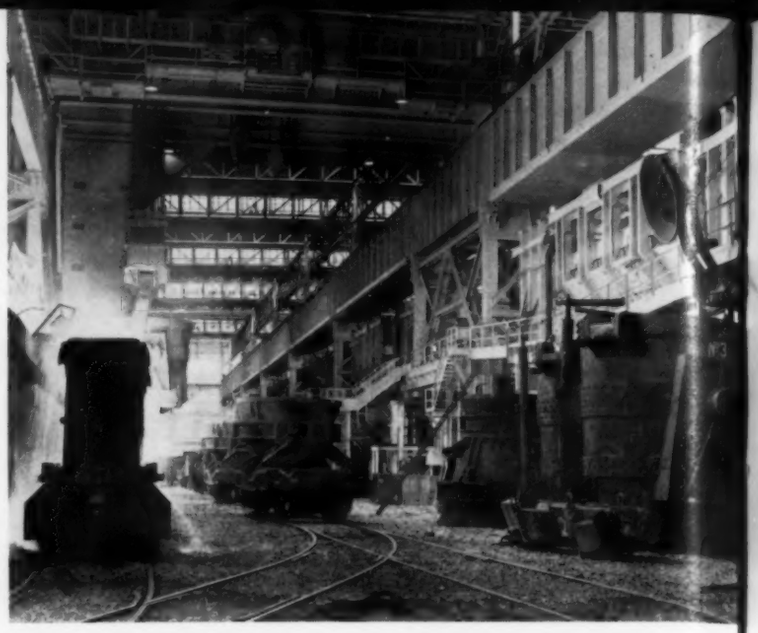
Water cooling is applied only to the integral frames which form the door jambs and arches, to the doors themselves, and to the doghouse roofs.

Furnace flues, 5 ft wide × 7 ft 6 in. high, lead to steel, brick lined stacks, 150 ft high × 7 ft diameter. The furnaces are reversed by electrically operated combination air-admittance and stack dampers. Air for combustion is provided by a fan, with the amount delivered to each chamber independently regulated.

The furnace hearths are built up of 1½ in. of insulating concrete, 6 in. of firebrick, 3 in. of chrome-magnesite brick, and, in the tap hole area, 21 in. of magnesite brick, all topped by a burnt-in bottom of magnesite mixed with some basic slag.

All furnaces are fired with fuel oil, which is stored in two 5000-ton tanks. Three unloading pumps of 199 ton per hr capacity and three circulating pumps of 6000 gal per hr capacity are provided. The oil is preheated in automatic heaters and the oil line is steam-tracered throughout its length. At each furnace, oil pressure, which is maintained at 150 psi in the circulating system, is automatically regulated.

Each furnace has an instrument panel which carries recorders showing roof temperature, air flow, oil flow, steam flow, furnace pressure, stack draft, regenerator temperatures, and an indicator for steel temperature as measured by an immersion thermocouple, as well as the controls for oil flow, fuel-air ratio and furnace pressure. The panel also carries switches for reversing the furnace and operating doors and fan.



Heats are tapped into 200-ton ladles which are handled for pouring by 300-ton cranes.

Each furnace is equipped with a water-tube waste heat boiler operating at 325 psi, 625 F, and producing about 10,000 lb of steam per hr.

Scrap is loaded into 40-cu ft charging boxes by four 10-ton magnet cranes in a two-level scrap bay which contains two tracks for drags of charging buggies and two tracks for railroad cars so arranged that the tops of the charging boxes are level with the tops of the railroad cars. On the lower level is a storage area which will hold about 13,000 tons of scrap. Scrap may be unloaded from the railroad cars directly into the charging boxes or into the storage, as conditions dictate.

Materials such as limestone, dolomite, ore, roll scale, etc., are handled in another parallel bay. These materials are unloaded from hopper cars into bunkers on the lower level, from where the materials are picked up by grab buckets and loaded into charging boxes standing on buggies on the high level.

On the charging floor, charging boxes are emptied into the furnaces by three 10-ton floor type charging machines.

TABLE II

	Port Talbot and Margam	Margam	Abbey
Rated capacity, tons	80	80	200
Bath length at foreplate level, ft-in.	35-0	35-0 to 37-0	51-8
Bath width at foreplate level, ft-in.	12-0	12-7 to 13-7	16-0
Bath area at foreplate, sq ft	340	427 to 436	766
Bath depth at center, in.	30	22 to 30	32
Size of uptakes (two per end)	6 x 4	4 x 6	6 x 8
Uptake area per end, sq ft	48	46.5 to 48	96
Height, center of roof above sill, ft-in.	7-2⅞	.....	.....
Door size, width x height, ft-in.	.....	4-0 x 4-3	Varies
Slag pocket volume, each end, cu ft	680	1150	2350
Length of checker work, ft-in.	18-9½	21-8	26-0
Width of checker work, ft-in.	(2) 10-0	7-0 and 9-1	(2) 13-4½
Height of checker work, ft-in.	10-6	9-4	15-9¾
Volume of checker work, each end	3948	3232	9933
Size of checker flues, in.	9 x 9	.....	(6) 7½ x 7½ (2) 9 x 9
Type of back wall	Sloping	Various	Sloping
No. of doors	5	3	5
Combustion air supply	Forced	Neutral	Forced

Hot metal comes from the blast furnaces in 80-ton ladles which are poured direct into the top of either of two 800-ton barrel type mixers. Both mixers pour out into 75-ton transfer ladles on cars which rest on a track scale while being filled. An electric locomotive then pushes the cars down the hot metal track to the furnaces, where a hot metal crane picks up the ladle and empties it into the furnace.

Hot metal analysis normally runs 0.7 per cent silicon, 0.9-1.0 per cent phosphorus, 0.06 per cent sulphur, and 1.0 per cent manganese. Much of this must be desulphurized with soda ash before use.

Heats are tapped into 200-ton ladles which are handled by three 300-ton ladle cranes, each with 60-ton and 20-ton auxiliary hoists. All ingots are poured at three pouring platforms onto buggies. Ingot sizes range 27¼–32¾ in. in thickness, 36–66 in. in width and 70–82½ in. in height. Weights range 17,000–44,300 lb.

Ingot buggy trains, on radio instructions to the locomotive from a dispatcher, are taken to the stripping bay where molds are removed by two 200-ton screw type stripping cranes. The train is then taken to the soaking pits where the ingots are charged, and the empty train is then returned to the stripper bay where the molds are replaced. The train is then moved to the mold department, where each mold is scraped, wire brushed and sprayed with graphite wash preparatory to reuse.

Overflow slag from the ladles is caught in 400-cu ft slag pots of the type used under the furnace to catch flushing slag. Two of these pots are placed by cranes on a car which is then moved to the slag yard. There the pots are tipped up to spill out the slag, which is sprayed with water, broken up, searched by a magnet for metallics, and finally removed for the blast furnaces or for the slag dump.

The normal charge for the Abbey furnaces consists of approximately 110 tons of hot metal, 110 tons of scrap, 12 tons of iron ore and 21 tons of limestone. During charging and melting, heat input is held at about 90,000,000 Btu per hr, and is reduced to about 60,000,000 Btu per hr during refining. Roof temperature is kept at about 2950 F. Immersion pyrometer readings are taken during refining; a tapping temperature of 2875 F is aimed at for rimming grades.

SLABBING MILL

Heating facilities for the Abbey works slabbing mill consist of 20 recuperative pits, 20 ft × 16 ft, and 11 ft deep, arranged in a double row. Each pit is fired through the bottom with mixed gas of 135 Btu per cu ft calorific value. Combustion air is preheated in refractory tile recuperators. Two pits are also equipped with gas preheaters, which may also be installed on the other pits if required.

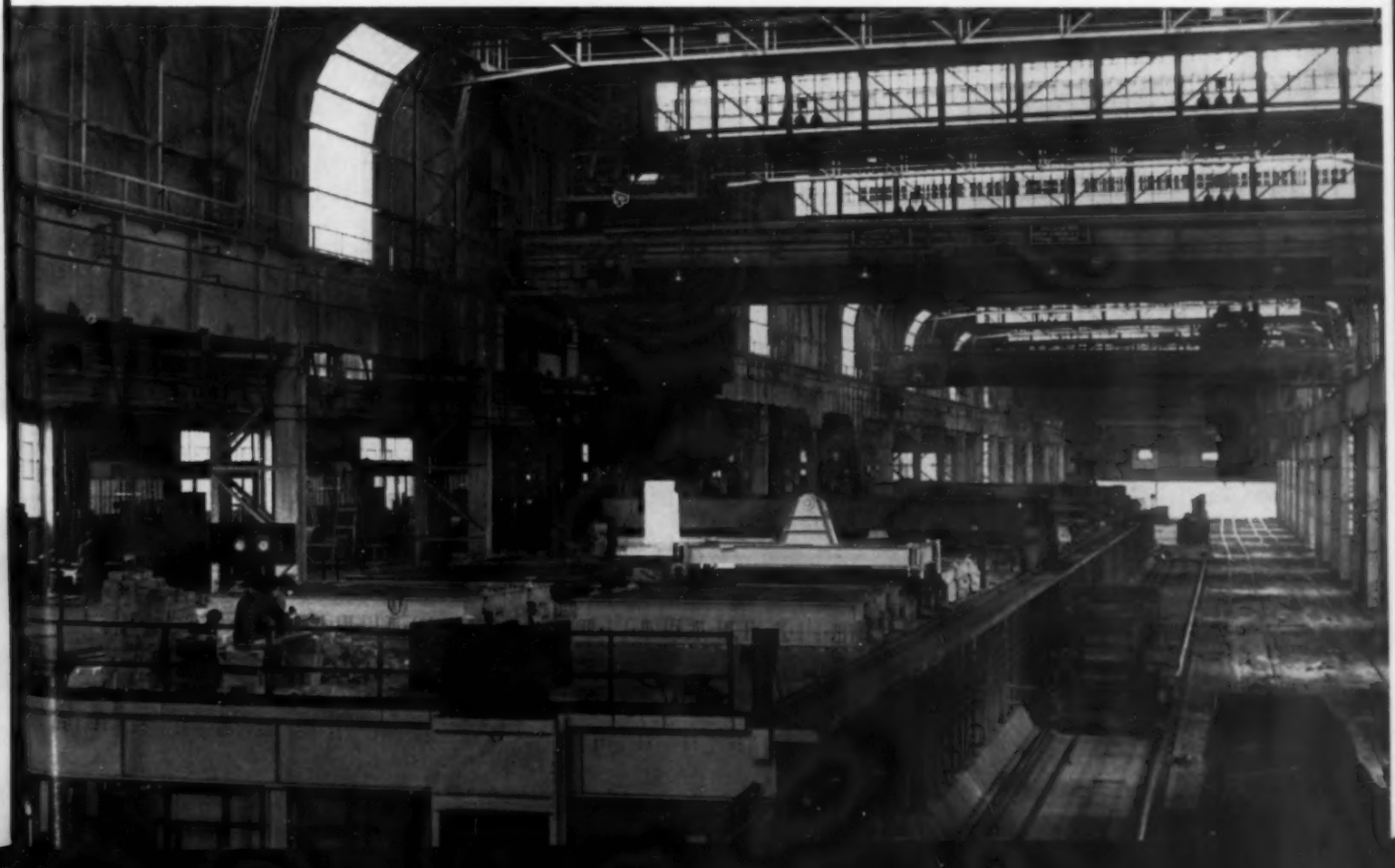
Each pair of pits exhausts into a common flue leading to a stack 100 ft high and 5 ft in diameter. A butterfly damper controls the pressure in each pit.

Pit covers are flat and are moved by one of two 40-ton cover cranes spanning the double row of pits.

Instruments for recording and controlling gas and air flow and pressure, pit pressure and temperatures, etc., are mounted on panel boards housed in glass-enclosed rooms. Pits are drawn according to a signal given by the temperature control which is set for a predetermined correct soaking temperature.

Ingots are handled into and out of the pits by two

Twenty recuperative pits, fired with 135 Btu mixed gas, heat ingots for the slabbing mill.



20-ton pit cranes, and are carried to the mill by a tilting buggy traveling at speeds up to 860 fpm. The buggy is automatically stopped by limit switches, and after dumping the ingot on the mill approach table, returns to the pit selected by the heater, where it is stopped by photo-cell control.

The ingot passes to a weighing and turning device and then to the 45-in. two-high reversing mill. This mill, which will handle ingots up to 66 in. in width and 55,000 lb in weight, is driven by twin double-armature 4600-hp motors in a normal speed range of 40–80 rpm. The rolls, which run in roller bearings, have a body length of 115 in., with a 71-in. bullhead and grooves of 14, 9½ and 6 in. Rolls are mechanically counterbalanced, and are lifted at speeds up to 34 fpm by 18-in. screws driven by two 200-hp motors. Maximum roll lift is 68 in.

The twin drive on this mill is capable of a peak torque of 3,600,000 ft-lb at speeds up to 40 rpm, and torques corresponding to peaks of 27,600 hp at speeds between 40 and 80 rpm. Power for these motors is provided by a motor-generator set consisting of a flywheel, and four 1850-kw, 550-volt d-c generators driven by a 6500-hp, 11,000-volt, 500-rpm induction motor. The flywheel, of steel plate construction, stores 200,000 hp-sec, sufficient to cover estimated demands with a speed drop of not more than 20 per cent.

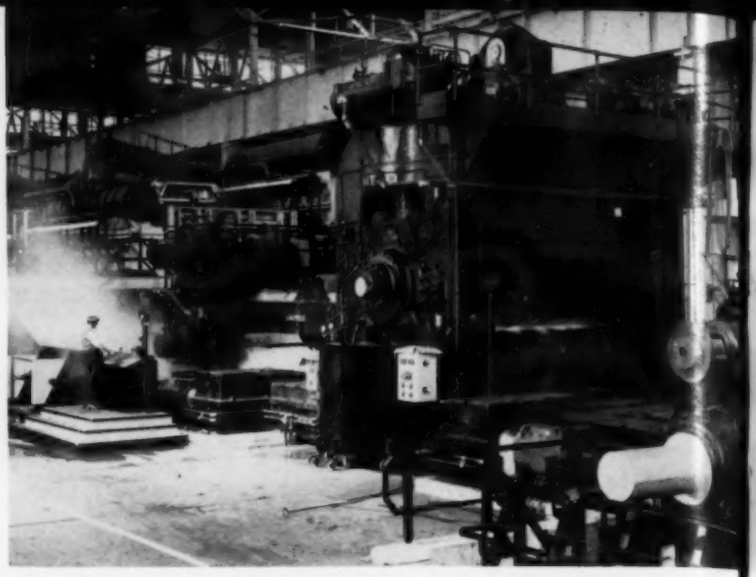
The drive motors and their generators are controlled from a foot-operated master controller in the pulpit, seven speeds being available between 0 and 40 rpm, and six more speeds between 40 and 80 rpm. The controller acts in the field circuits of two special control exciters which in turn control two main exciters connected in the motor and generator field circuits.

All main electrical machines are force ventilated by two recirculating systems. In these systems, the air that passes over the commutators, collecting brush dust, is removed from the system by exhaust fans, and is made up by fresh air pulled through electro-static precipitator filters.

Electrically driven side guards are provided on each side of the mill, with a turn-over device only on the entry side.

The 45-in. mill produces slabs up to 18 ft × 5 ft × 8 in.

The 45-in., high-lift, reversing, slabbing-blooming mill is driven by twin, double-armature motors of 4600-hp each.



This view shows the 130-in. broadside mill, preceded by the roughing scalebreaker. Heating furnaces are in the background.

From the mill, slabs pass down the table to a vertical edger 94 ft distant. The edging rolls, adjustable for widths of 20–84 in., are driven by an 800-hp motor at a maximum surface speed of 350 fpm. Following the edger, provisions were made for an automatic scarfing machine should it be required later.

Located 135 ft beyond the edger is the slab shear of down-and up-cut design. Driven by two 500-hp motors, it operates at nine strokes per minute and is capable of exerting a pressure of 3,000,000 lb, sufficient to cut 60 in. × 10 in. slabs. Crop ends drop beneath the table and are moved by inclined skip hoist, at right angles to the mill line, for discharge outside the building.

Slabs are weighed in the shear runout table, and are pushed on to a chain conveyor positioned at right angles to the mill line. Pneumatic stamping machines mark the slabs while on this conveyor.

The chain conveyor discharges on to a roller table which feeds two pilers. Piles of slabs are pushed on to either of two transfer cars delivering to the slab yards, of which there are two, each 1153 ft long × 93 ft wide.

HOT STRIP MILL

In the slab yard, slabs are piled according to the strip mill schedule and placed on depilers, one at each end of the charging table which runs across the back ends of the slab heating furnaces.

Heating facilities for the strip mill consist of three continuous triple-fired furnaces, each rated at 105 tons of steel per hour. Effective hearth dimensions are 20 ft wide × 86 ft long. Eight burners overfire the soaking zone, while the main heating zone is overfired with six burners and underfired with five burners. The fuel is coke-oven gas and/or oil, and the furnaces are equipped with a full complement of controls and instruments to provide automatic or manual control as desired, mounted on an individual panel for each furnace.

Located beneath the furnaces are refractory tile recuperators in which air for combustion is heated to about 800 F. Furnace gases leaving the recuperators pass through waste heat boilers and up through a stack 165 ft high.

The six finishing stands, spaced on 19-ft centers, are driven by 800-volt, d-c motors which receive power from mercury-arc rectifiers.

The hot strip mill is designed to produce coiled strip or sheared lengths of sheet or plate in widths of 27–74 in., and thicknesses of 0.05–0.75 in. Coils may weigh up to 30,000 lb.

The slab, discharged at rolling temperature from one of the heating furnaces, travels first to a two-high 36 × 72 in. scalebreaker, driven by a 1250-hp, 3300-volt, 375-rpm slip ring induction motor. Next, at a distance of 30 ft, is located a four-high, 42 and 54-in. × 130-in. broadside unit, driven by a 3500-hp, 11,000-volt, 500-rpm slip ring motor. Slabs may pass through this stand straight away or, if not exceeding 8 ft 6 in. in length, may be cross-rolled in order to spread them to a greater width than the maximum available from the slabbing mill. A slab turn-table is placed on both sides of this stand to bring the piece into position for broadside rolling and then restore it to its original axis. A slab pusher is also provided on the entry side of the broadside mill, insuring proper entry of the slab into the rolls. A slab squeezer, with opening to accommodate slabs of 28–90 in. width, follows the broadside mill and serves to true up the edges of slabs distorted by the heavy draft in the broadside mill.

Following the squeezer are three four-high roughing stands, the first two being 36 and 54 in. × 80 in. and the third 27 and 54 in. × 80 in. Each stand is driven by a 4500-hp, 500-rpm, 11,000-volt synchronous motor. The roughing stands are spaced 51 ft 4½ in., 60 ft, and 96 ft apart, so that the slab is in but one stand at a time. The last three roughers are equipped with integral vertical edging rolls on the entry side.

Just ahead of the finishing train, which is spaced 186 ft from the last rougher, is a crop shear for trimming the head and tail ends of the strip. This shear may be operated automatically from a photo-electric time relay.

Between the crop shear and the first finisher is a pinch roll device having three 14-in. rolls on the bottom, and two 21-in. spring-loaded rolls on top. This unit acts as a secondary scalebreaker and assists entry of the steel into the finishing train.

There are six four-high, 27 and 54 in. × 80 in. finishing stands, spaced on 19-ft centers. The first two are driven through reduction gearing by 4500-hp, d-c motors, the next three are direct driven by 5000-hp, d-c motors, and the last stand is direct driven by a 4000-hp, d-c motor.

The hot mill motor room is ventilated by a closed, recirculating system, with make-up air cleaned by electrostatic precipitators.

TABLE III

Strip Mill Data

Stand designation	Two-high or four-high	Length of work roll body, in.	Nominal diameter of rolls, in.		Distance from preceding stand, ft-in.	Motor data					Gear ratio	Roll, rpm		Strip speed, fpm	
			Work	Backup		Hp	Type of motor	Volts	Rpm, min	Rpm, max		Min	Max	Min	Max
ABBEY WORKS															
Hot strip mill															
Roughing scalebreaker	2	72	36	..	.....	1250	Induction	3,300	.....	375	15.9	.....	23.6	.....	222
Broadside	4	130	42	54	30-0	3500	Slip ring	11,000	.....	500	24.7	.....	20.2	.....	222
No. 2 rougher	4	80	36	54	51-4½	4500	Synchronous	11,000	.....	500	18.9	.....	26.4	.....	249
No. 3 rougher	4	80	36	54	60-0	4500	Synchronous	11,000	.....	500	15.1	.....	33.1	.....	313
No. 4 rougher	4	80	27	54	96-0	4500	Synchronous	11,000	.....	500	8.25	.....	60.6	.....	429
No. 5 finisher	4	80	27	54	186-0	4500	d-c	800	125	282	4.66	26.9	60.6	189	426
No. 6 finisher	4	80	27	54	19-0	4500	d-c	800	125	282	2.61	47.9	108.0	339	765
No. 7 finisher	4	80	27	54	19-0	5000	d-c	800	78	156	Direct	78.0	156.0	551	1102
No. 8 finisher	4	80	27	54	19-0	5000	d-c	800	105	210	Direct	105.0	210	742	1484
No. 9 finisher	4	80	27	54	19-0	5000	d-c	800	125	250	Direct	125.0	250	884	1768
No. 10 finisher	4	80	27	54	19-0	4000	d-c	800	132	296	Direct	132.0	296	934	2095
Sheet skin pass mill	2	80	32	.....	.....	400	d-c	440	500	1000	.....	25	50	210	420
Coil skin pass mill	2	80	32	.....	.....	700	d-c	475	500	1000	.....	50	100	420	840
Tandem cold mill															
No. 1 stand	4	80	21	53	.....	4000	d-c	620	85	221	Direct	85.0	221.0	467	1215
No. 2 stand	4	80	21	53	13-0	4000	d-c	620	142	300	Direct	116	300	635	1650
No. 3 Stand	4	80	21	53	13-0	4000	d-c	620	170	370	Direct	142	370	780	2035
Reel	.....	.....	.....	.....	.....	1000	d-c	260	100	350	Direct	100	350	.....	.....
Sheet temper mill	4	80	20	49	.....	1000	d-c	600	300	600	6.15	47.7	95.5	250	500
Coil temper mill	4	80	20	49	.....	1000	d-c	600	300	600	2.61	114.6	229.0	600	1200
Combination temper mill	4	80	20	49	.....	1000	d-c	600	300	600	2.61	47.7	229.0	250	1200
TROSTRE WORKS															
Tandem cold mill															
No. 1 stand	4	48	21	53	.....	1750	d-c	600	90	230	Direct	90	230.0	495	1264
No. 2 stand	4	48	21	53	13-0	3500	d-c	600	125	273	Direct	125	273	687	1501
No. 3 stand	4	48	21	53	13-0	3500	d-c	600	200	400	Direct	200	400	1100	2199
No. 4 stand	4	48	21	53	13-0	4000	d-c	600	350	582	Direct	350.0	582	1924	3200
No. 5 stand	4	48	21	53	13-0	5500	d-c	600	500	818	Direct	500.0	818.0	2749	4497
Reel	.....	.....	.....	.....	.....	900	d-c	600	210	900	Direct	.....	.....	.....	.....
Temper mills															
Reel	.....	.....	.....	.....	.....	300	d-c	500	185	835	.....	.....	.....	.....	.....
Tension rolls	.....	.....	.....	.....	.....	500 & 250	d-c	500	735	1100	.....	.....	.....	.....	.....
No. 1 stand	4	48	18	53	.....	1000	d-c	500	700	950	Direct	700	950	1000	4000
No. 2 stand	4	48	18	53	13-0	1000	d-c	500	700	950	Direct	700	950	1000	4000
Tension rolls	.....	.....	.....	.....	.....	500 & 250	d-c	500	735	1100	.....	.....	.....	.....	.....
Reel	.....	.....	.....	.....	.....	300	d-c	500	185	835	.....	.....	.....	.....	.....
Reel	.....	.....	.....	.....	.....	300	d-c	500	185	835	.....	.....	.....	.....	.....
Tension rolls	.....	.....	.....	.....	.....	500 & 250	d-c	500	735	1100	.....	.....	.....	.....	.....
No. 1 stand	4	48	18	53	.....	1000	d-c	500	700	950	Direct	700	950	1000	4000
No. 2 stand	4	48	18	53	13-0	1000	d-c	500	700	950	Direct	700	950	1000	4000
Tension rolls	.....	.....	.....	.....	.....	500 & 250	d-c	500	735	1100	.....	.....	.....	.....	.....
Reel	.....	.....	.....	.....	.....	300	d-c	500	185	835	.....	.....	.....	.....	.....
ORB WORKS															
Reversing cold mill	4	48	16	53	.....	2500	d-c	600	93	232	Direct	93.0	232.0	400	1000
Reel	.....	.....	.....	.....	.....	(2)500	d-c	600	200	650	.....	.....	.....	.....	.....

The three-stand tandem mill at Abbey works is designed to reduce strip up to 74 in. wide from 0.08-0.14 in. down to 0.025-0.078 in. in thickness.

Roll neck bearings of the two-high roughing scale-breaker are of the oil-flooded type. Back-up rolls of all four-high stands use the same type of bearings, while their work rolls run in roller bearings.

Hydraulic balance is maintained in the roll assemblies of all stands by two oil-hydraulic systems consisting of pump, tank, strainer, weighted accumulator and operating valves. One system serves the roughing train, the other the finishing train.

Strip temperatures are measured ahead of the broadside stand, on the holding table, between No. 9 and No. 10 stands, and just ahead of the coilers. Each measurement is indicated locally, and recorders are grouped together opposite the finishing train.

On each mill stand, screws are operated by two 440-volt, d-c motors, ranging 25–75 hp on the various stands. The two motors may be connected through a magnetic clutch, so that the screws on one stand may be operated individually or in unison. Screwdown controls for the roughing stands are located on each stand, while speed control is concentrated in one pulpit. For the finishing stands, screwdown controls are located on each stand and duplicated in the speed pulpit, where it is intended to control both speed and screw changes for section.

Descaling sprays are located at the exits of stands No. 1, 2, 3 and 4. Taper sprays are in front of stand No. 5. Water for the descaling sprays comes from either of two pumps rated at 1200 gpm, 1200 psi.

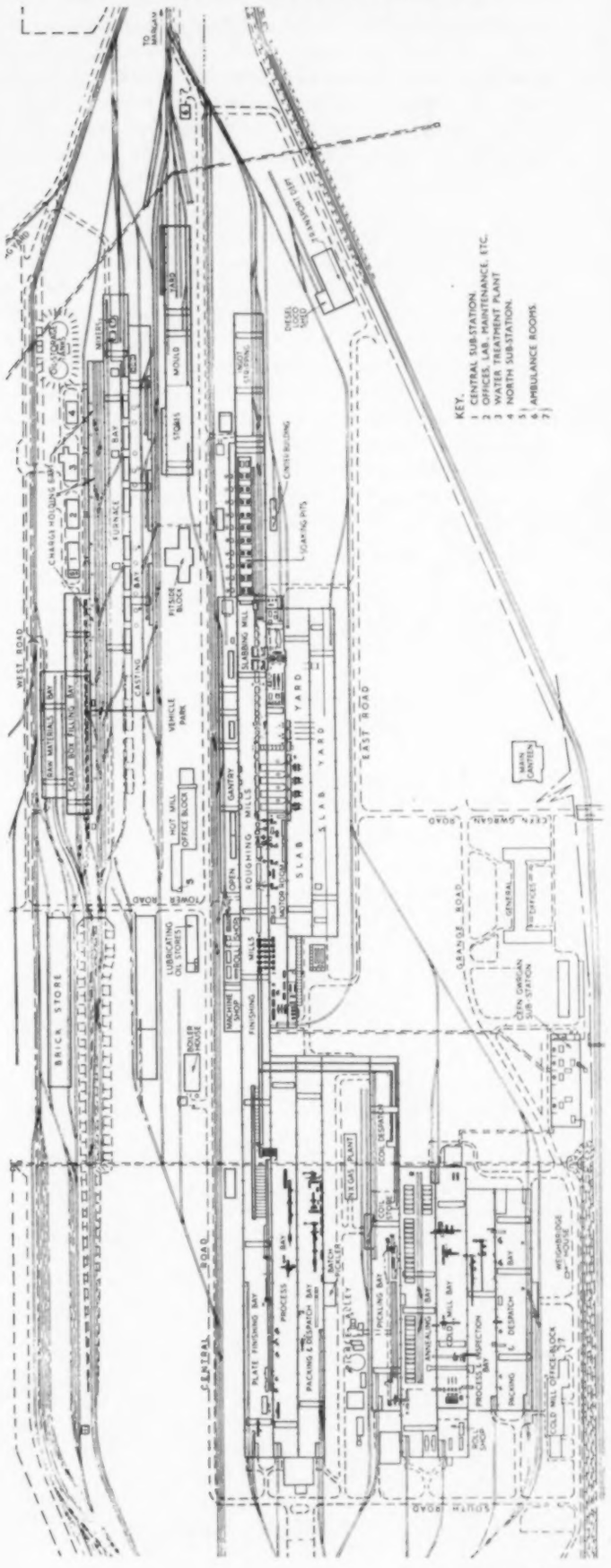
Mill scale drops down into flumes beneath the mill and is washed to settling pits, from which scale is removed by bucket and gantry crane. The water is reused either for scale flushing or, after clarification, in the general plant system.

Following the last finishing stand is a flying shear capable of cutting product up to $\frac{1}{4}$ in. $\times$ 76 in. into various lengths as desired up to 30 ft. As strip, sheets or plates pass down the runout table, water sprays may be applied to cool the product to the desired temperature. The runout table, which is 316 ft long, is composed of individually driven table rollers, operating under adjustable voltage control.

Strip is directed to either of two down-coilers by pinch roll units having a 36-in. top roll and a 12-in. bottom roll. The coilers are of collapsible mandrel type with 30-in. diameter drums, and form coils of 60-in. maximum outside diameter.

Each coiler discharges onto a separate conveyor fitted

View shows general layout of Abbey works.



with a weighing section. The coils are then conveyed either to the heavy-gage coil stocking bay or to the extension of the pickling department.

The hot mill motor room, 800 ft long × 70 ft wide, is located between the slab yard and the hot mill building. Here are housed all main hot mill drives with their reduction gear sets, control equipment, switchgear, etc. The slip ring induction motors driving the scalebreaker and broadside stands are controlled through slip regulators arranged for a 20 per cent speed drop at 100 per cent overload. The synchronous motors driving the other roughing stands are controlled by three-phase reactors, and have pullout torques 3½ times full load.

The d-c motors driving the finishing train are controlled by an adjustable voltage system and receive their power from a bank of mercury-arc rectifiers totaling 21,000 kw at 800 volts. Power from the 11,000-volt system is led to the rectifiers through five separate main oil circuit breakers, and then through reactors and phase-shifting auto-transformers to the rectifier transformers. The 30 rectifiers are of the permanently sealed, pumpless steel tank type. Each rectifier tank has six anodes and is provided with control grids. The main rectifier transformers have their primaries alternately star and delta, so that each group of six rectifier tanks forms a 12-phase rectifier.

Electrical machinery in the motor room is ventilated by a closed, recirculating system, with make-up air being cleaned by electrostatic precipitators. Separate fans extract the air used to cool the commutators of the drive motors so that brush dust is not circulated through the system.

HOT FINISHING

Plate finishing facilities are installed near the end of the hot strip mill. Plate material leaving the mill passes over the coilers and on to a runout table, from which it is removed over a chain transfer to a parallel table feeding a roller leveler. It then passes over a cooling bed to another table leading to a dividing shear and pilers. A rotary side trimmer and an end shear are installed to complete the processing after the piles of plates have cooled.

Hot rolled sheets, which have been cut to length on the flying shear at the hot mill, are transported from the hot mill pilers over a chain transfer to an adjacent finishing department. Here are installed a resquaring line, a sheet skin-pass mill, resquaring shears, and a roller leveler. The mill is a 32 in. × 80 in., two-high unit driven by a 400-hp, 500-1000 rpm, 440-volt d-c motor which receives power from a 330-kw grid-controlled rectifier.

Hot rolled coil finishing is carried out in an adjacent bay which contains a coil skin-pass mill, a slitting line, a cut-up line, a batch pickler, a scrubbing line, and two oiling machines. The mill is a 32 in. × 80 in., two-high stand driven by a 700-hp, 500-1000-rpm, 475-volt, d-c motor. Two 320-hp, d-c motors drive the uncoiler and the coiler, both so controlled as to provide tension on each side of the mill as desired. The entire drive draws power from a 1250-hp motor-generator set.

This five-stand cold reduction mill at Trostre works can roll strip down to 0.006 in. in thickness.

COLD ROLLED FINISHING

One continuous pickling line is installed, with provisions for a second when needed. The line is designed to take coils 24-74 in. wide, and up to 60 in. outside diameter, of material 0.05-0.14 in. thick. Coils are placed by crane on a down-ender and gravitate to a side tilter which discharges to a ramp fitted with three air stops.

The line consists of an uncoiler, a scale-breaking processor, rough leveler rolls, an up-cut shear, a flash welder and flash trimmer, a stitcher, a looping pit, four acid tanks, a water spray tank, a dryer, an up-cut shear, an oiler and a coiler.

Acid tanks are 80 ft long and 4 ft deep and are of steel plate construction, lined with rubber and brick. The water spray tank is 19 ft long and 18 in. deep, and contains four cold water spray pipes followed by 16 hot water spray pipes.

All tanks are hooded, and the fumes are piped to a battery of four scrubbing towers. Waste water from the sprays is piped to a water neutralizing plant, while spent acid is treated with hydrated lime and the resulting sludge dumped.

The pickling line operates at speeds of 90-360 fpm.

The pickled coil is ejected from the up-coiler to a gravity conveyor, weighed, and delivered to storage.

In the cold mill bay is a three-stand, 21-in. and 54 in. × 80 in., four-high tandem cold mill, designed to reduce pickled, mild steel from 0.08-0.14 in. thickness, down to 0.025-0.078 in. thickness, with widths ranging up to 74 in.

Coils running up to 40,000 lb in weight are moved to the mill over a ramp, back spun and moved into the coil box. The strip is fed to the mill through pinch rolls.

Each mill stand is driven by a 4000-hp, double armature, d-c motor connected directly to the mill pinions. These motors operate under adjustable voltage control and receive power from a motor-generator set made up of six 1625-kw, 620-volt, d-c generators and two 415-kw, 260-volt, d-c generators, all driven at 750-rpm by two 7500-hp, 11,000-volt synchronous motors.

Upon leaving the mill the strip is recoiled on a collapsible mandrel reel driven by a 1000-hp, 100-350-

rpm, double-armature d-c motor. Maximum exit speed of the strip is 2035 fpm.

Coils to be annealed are transferred over a pallet type conveyor to the annealing department, where 12 portable cover type furnaces and 36 bases are provided. Eight furnaces are arranged for coils up to 74-in. in diameter in stacks up to 12 ft 6 in. high, and four for sheets in maximum piles of 27 ft × 6 ft × 6 ft.

The furnaces are direct fired, each being equipped with multiple burners for coke oven gas. They are completely automatic and regulated from a central control room equipped with all necessary instruments.

Inner covers are fabricated of $\frac{3}{16}$ in. alloy steel.

Four 8000 cfhr gas generators, in which coke oven gas is burnt with a controlled amount of air, provide atmosphere gas for the annealing process. The burnt gas is passed through a CO_2 stripping unit and through two dryers, and has a final analysis of 97 per cent nitrogen, 1.2 per cent hydrogen, 1.5 per cent carbon monoxide, and traces of methane and carbon dioxide.

Annealed sheet and coil may be temper rolled on one of three temper mills, all 20 in. and 49 in. × 80 in. four-high units, and each driven by a 1000-hp, 300-600 rpm, 600-volt d-c motor. One unit, designed to handle sheets, operates at a speed of 250-500 fpm. The drive on this unit receives power from an 800-kw grid-controlled rectifier. Another unit, designed for coils only, operates at 600-1200 fpm, while the third, arranged to handle either sheets or coils, runs at 250-1200 fpm. Each of these drives are powered from a 1600-hp, motor-generator set.

Three cut-up lines, a stretcher leveler, and five oiling machines are also installed in the cold mill department.

TROSTRE PLANT

Trostre plant, some 20 miles from the Abbey works, is intended primarily for the production of tin plate, although its design permits it to handle some other products as well. Coils up to 15,000 lb in weight, and up to 38 in. in width and 0.093 in. gage, are transported from Abbey in special 42-ton cars and are unloaded into stock.

From stock, coils are moved by cranes to two pallet type conveyors which feed the continuous pickler. This unit is of conventional design with an uncoiler, a scale-breaking processor, a roller leveler, an up-cut shear, a flash welder and flash trimmer, a stitcher, a looping pit, five acid tanks, a cold water spray tank, a hot water tank, a dryer, a looping pit, an up-cut shear, a side trimmer, an oiler and a three-roll up-coiler.

Two electrolytic tinning lines operate at speeds up to 800 fpm when depositing a ½ lb coating.

The acid tanks, 80 ft long × 48 in. wide, are of steel plate construction and lined with rubber and brick. Water tanks are of similar construction, one being 21 ft 4 in. long, the second 23 ft 3 in. long. All tanks are hooded and vented through two 30,000-cfm fans to a 72-in. diameter stack.

Maximum speed of the strip through the tanks is 500 fpm, while the entry unit can attain a maximum speed of 1000 fpm.

The five-stand cold reduction mill is capable of producing coiled material down to 0.006 in. thick from hot rolled, pickled strip 0.07–0.083 in. thick at speeds up to 4500 fpm. Finished coils will be 20 in. inside diameter, and up to 72 in. maximum outside diameter, up to 44 in. wide, and up to 30,000 lb maximum weight.

Details of the drives on this mill are given in Table III. The motor on the first stand is a single armature unit. The second, third and fourth stand motors are double armature, and the fifth motor has three armatures. The motors receive power from two motor-generator sets.

Power is furnished to these motors by two motor-generator sets, each driven at 750 rpm by an 11,580-hp, 11,000-volt synchronous motor. One set has five 1600-kw generators, and the other five 1600-kw generators, and one 720-kw generator, all of 600 volts d-c. Each generator is connected directly to a motor armature on the mill drives, with no common bus bar. Thus, there is one generator for No. 1 stand motor, two generators each for No. 2, 3 and 4 stand motors, and three generators for No. 5 stand motor.

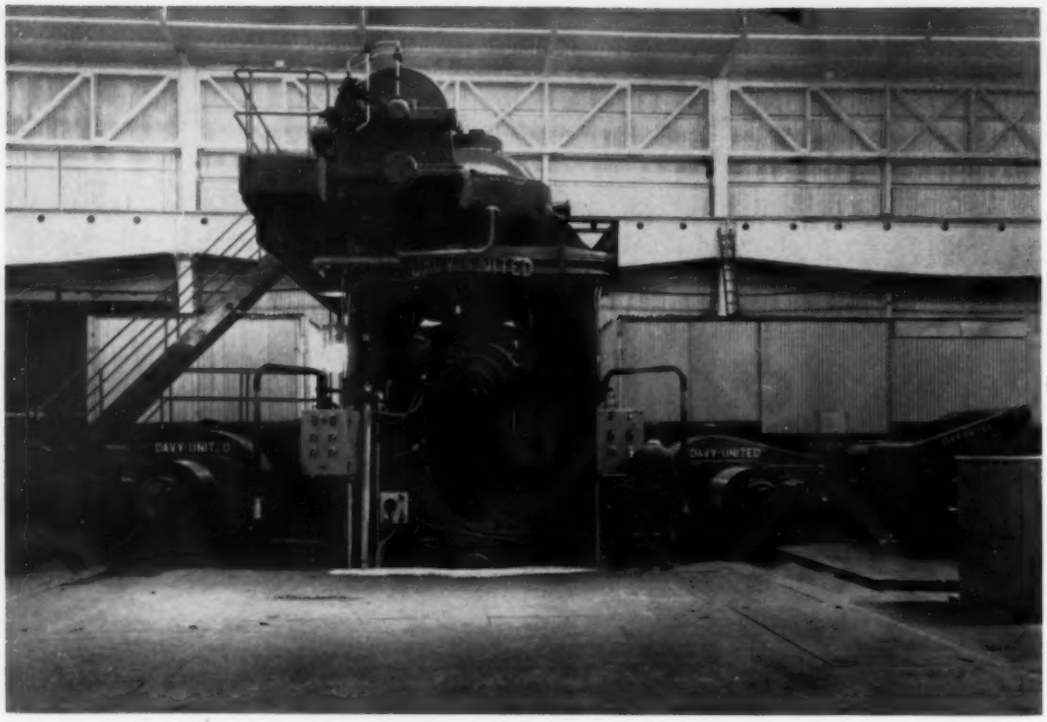
The units of the multi-armature motors are not connected in parallel, as is usual in the United States, but in staggered series (generator-motor-generator motor) so that the working voltage is nowhere above that of a single unit.

Between each stand the strip is lubricated with palm oil and passes through wiper boxes before entering the rolls. Palm oil is recovered from the cooling water in a reclamation system and the water is then recirculated.

Leaving the mill, the strip is led by a belt wrapper to engage a collapsible mandrel reel, where coils up to 30,000 lb are formed. The coil is stripped from the reel on to a cradle and ejected on to a coil ramp, over which it rolls to an automatic weigher and recorder, and then to a conveyor.

After cold rolling, palm oil is removed from the strip in either of two electrolytic cleaning lines capable of operating up to 2000 fpm. Each of these units contains a pay-off reel, a down-cut shear, a double-seam flash welder, a 22-ft caustic dip tank, a scrubbing unit, a 65 ft 8 in. electrolytic tank, a second scrubbing unit, a 20-ft hot rinse tank, a hot-air dryer, pinch rolls, a looping pit, tension rolls, a second shear, and a collapsible mandrel reel.

The electrolytic tank contains four grids above the strip and four below, operating at 15 volts and 4000 amp. Their polarity is adjusted so that the surface of the strip is alternately anodic and cathodic during its travel. The electrolyte is a detergent, principally hydroxide, silicate and carbonate of sodium, heated by steam coils.



Silicon steel strip can be reduced down to 0.012 in. in thickness in this 48-in. reversing cold mill at Orb works.

Annealing is performed in direct oil-fired portable cover type furnaces 28 ft 6 in. long × 17 ft 6 in. wide × 15 ft 3 in. high. There are seven such covers serving 15 bases, each of which will take eight 132-in. stacks of 54-in. coils. Each stack is covered by a 66½ in. stainless steel inner cover. Thirty burners supply heat, and a row of three exhaust ports in the bottom between the two rows of coils conducts combustion products to flues in the basement. The gases then pass through a header to a 75-ft venturi stack.

Annealing atmosphere is supplied by three generators, each rated at 12,000 cfhr. The gas, generated from kerosene, has a final analysis of approximately 94 per cent nitrogen, 1.5 per cent hydrogen, 4.5 per cent CO, and traces of CO_2 and methane.

After annealing, coils are skin passed in either of two duplicate temper mills. Coils are moved from the annealing department to the temper mills by a 62-ft pallet-type conveyor. A hydraulically operated upender and hydraulically operated charging car take a coil from the conveyor and engage it on the expanding mandrel of the mill pay-off reel. The strip passes around a pair of entry tension rolls, over a small anti-crimping roll and into the mill.

The two stands of each mill are identical four-high, 18-in. and 53-in. × 48-in. units, each driven directly by a 1000-hp, 700–950-rpm, 500-volt d-c motor. Maximum delivery speed of the mill is 4000 fpm.

Leaving the mill, the strip passes through a set of exit tension rolls, substantially a duplicate of those on the entry end, and is then recoiled.

After temper rolling, coils may be put through two coil preparation lines, where they are side trimmed and welded together to form coils up to 30,000 lb in weight, or through three cut-up lines where they are side trimmed and cut up into lengths of 18-37½ in. for hot dip tinning.

Two electrolytic tinning lines are installed, with a maximum speed of 800 fpm when depositing a ½-lb coating and corresponding lower speeds for heavier coatings. Strip is fed from the pay-off reel, through pinch rolls to a double cut shear and then to a seam welder, looping pit and entry tension bridle. Next, the strip passes through three rubber-lined steel tanks 9 ft deep and a brush machine. In the first tank, the strip is subjected to electrolytic degreasing at 200 F and a current density of 100-150 amp per sq ft in an alkaline detergent. In the second tank, the carry-over of the detergent is removed by high-pressure sprays and brushes. In the third tank, electrolytic pickling is performed in a dilute solution of sulphuric acid.

The plating section consists of five rubber-lined electrolytic tanks, 9 ft deep, and a sixth tank for drag-out recovery, through which the strip passes in vertical loops. Each tank has four anode feeder bars, one at each side of each leg of the loop. Each bar supports a series of anodes 5 ft 9½ in. deep by 3 in. wide by 2 in. thick. Selenium rectifiers supply direct current up to a maximum of 60,000 amp at 16 volts. Amperage is varied with the speed of the line, the width of the strip, and the weight of the coating being deposited. The plating electrolyte is a solution of stannous tin and isomers of phenol-sulphonic acid, with some additive agents.

Following the plating section is a muffle furnace tower in which the tin coating is reflowed by electrical conduction heating. The strip then passes through water to quench the tin, and is electro-chemically treated in a weak solution of alkali chromate and phosphate at a temperature of 200 F. Next come water sprays, a steam dryer, and an electrostatic oiler which applies a coating of cotton seed oil, followed by the main drive bridle which pulls the strip through the line. The strip is then cut to length by a flying shear and the plate passes to a classifier and piler.

Hot dip tinning is performed in nine pots which are highly mechanized and automatically controlled. The plate is electrolytically pickled, tinned, wet washed, dry cleaned, inspected and classified in these lines.

ORB WORKS

The Orb works, located at Newport, some 35 miles from Port Talbot, was acquired from John Lysaght, Ltd., in 1947. This plant, specializing in the production of electrical sheets, contains a number of mechanized and semi-mechanized sheet mills. A four-high 16 in. and 53 in. × 48 in. reversing cold mill, driven by a 2500-hp motor, has been recently installed. This unit will reduce silicon steel strip 24-42 in. wide from 0.097 in. thickness down to 0.012 in. With rolling speeds of 400-1000 fpm, production will range 7-8 tons per hr.

The mill also rolls mild steel strip from 22,000-lb coils at speeds up to 1250 fpm. The higher speed is attained by substituting a 20½ in. diameter work roll for the 16-in. roll used in rolling silicon strip.

Galvanized sheets are also produced at Orb works.

SERVICES

The Port Talbot, Margam and Abbey works form an integrated unit served by a common electrical system. They contain some 6000 electric motors of all sizes, totaling about 175,000 hp. The plant load, which goes as high as 50,000 kva demand, is carried principally by purchased power, with some plant generation.

Purchased power comes over four overhead lines, three of 40,000-kva capacity and one of 4000 kva. All four lines carry 50-cycle power at 66,000 volts to the points of supply where it is metered and reduced to 11,000 volts.

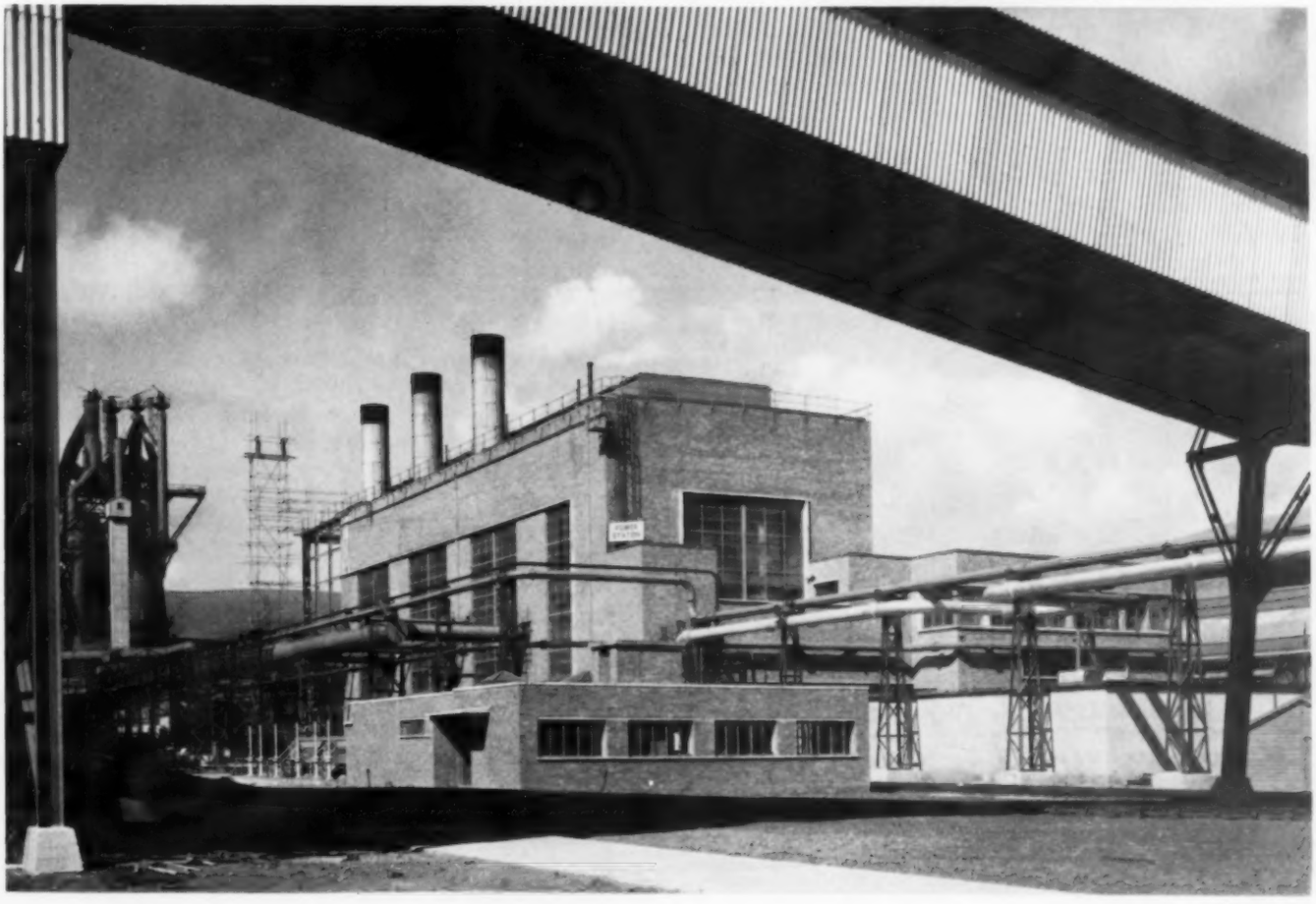
Generated power comes from two 8000-kw, 11,000-volt turbo-generators and one 1800-kw, 3300-volt unit, located at Margam works. Normally, generation will not exceed 14,000 kw or drop below 5000 kw.

The Cefn Gwrgan substation at Abbey works is the principal point of entry, and contains three 17,500-kva and three 10,000-kva transformers, all 66,000/11,000 volts. This station is mainly of outdoor type, but with a separate brick building for each of the 11 air-blast circuit breakers and another for relays, metering, etc.

For transmitting blocks of power of less than 5000 kva over short distances and for operating intermediate sizes of motors, 3300 volts was adopted. This supply is derived from the 11,000-volt system through 3500-kva transformers, and from the 1800-kw generator. Still lower voltages, 415/240 volts, 3-phase, are derived either from the 11,000-volt system, through 800-kva transformers or from the 3300-volt system through 400-kva transformers. The phase-to-neutral voltage of 240 is used for all fixed lighting. Portable lamps and tools use 110 volts, normally obtained from small 240/110 volt single phase transformers.

Direct current is used for cranes, various mill auxiliaries, boiler fans and numerous variable speed drives. At Margam, the existing 220-volt system using rotary converters, was retained, as was the existing 440-volt system at Port Talbot. Abbey works is supplied with 440-volt, d-c power from 1600-kw, 12-phase mercury arc rectifiers located in six sub-stations so placed as to keep d-c transmission as short as possible. There are also some smaller 6-phase rectifiers feeding isolated sections of the plant.

This power station, located at Margam works, contains two 8000-kw and one 1800-kw turbo-generators.



Steam generating facilities are arranged so as to take full advantage of all by-product fuels and waste heat. The chief steam plant is located at Margam, where four 625-psi, 820-F, boilers are installed, each of 87,200 lb per hr capacity. These units are fired with blast furnace gas, with coke gas or fuel oil as standby. There is no provision for solid fuel. This 600-lb steam goes to the blast furnace blowers and to the two 8000-kw turbo generators. The blower turbines exhaust at atmospheric pressure into the low pressure stages of the generator turbines, which are both equipped with 17,000 sq ft surface condensers.

There is also a 300-psi steam system supplied principally from the waste heat boilers on the Abbey open hearth furnaces. This steam is used for turbine driven auxiliaries, general plant usage and for the 1800-kw auxiliary turbo-generator. This unit discharges steam into a 160-psi pressure steam system for use at Margam works. As the 160-psi system also receives steam from the Margam waste heat boilers, any exhaust from the 1800-kw unit not needed at Margam is used for high pressure feed heating, and finally, at atmospheric pressure, in the lower stages of the main generator turbines.

The three steam systems are also interconnected by reducing valves.

There is another boiler plant at Abbey supplying steam for oil heating and atomizing, and for space heating. This house contains three 175-psi, 440-F boilers fired with blast furnace gas or coke breeze, each of 38,500 lb per hr capacity. Also supplying this system are the three waste heat boilers on the heating furnaces of the hot strip mill.

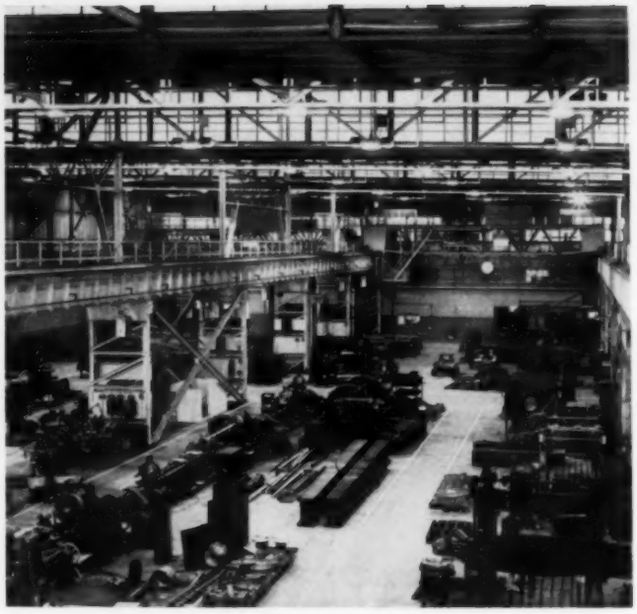
Water is obtained from various reservoirs which are connected to the plant site by natural streams, ditches, and concrete culverts. A new pumphouse, with water tower, clarification plant and cooling tower, is designed for the dual purpose of providing service water to the works and to discharge storm water to the sea. This station contains four 18,000-gpm pumps and four 5000-gpm pumps for storm water, and six 5000-gpm pumps for service water. Immediately outside the pumphouse is a concrete storm water collecting basin, necessitated by the possibility of 4½ in. of rain in 24 hr. Additional process water is obtained from the Kenfig River about 2½ miles away. The cooling tower is constructed of reinforced concrete in a parabolic design, and can handle 1,800,000 gal of water per hr, cooling it from 90 F to 75 F in average summer temperatures.

At Margam, approximately 86,000 gpm of cooling water is taken from the docks while some additional fresh water is taken from a nearby stream and from the company's own water system.

At Trostre works, electric power is purchased and transformed from 132,000 volts to 33,000 volts by a 45,000-kva transformer bank. The power is fed to three points in the plant at 33,000 volts and is then reduced and distributed at 11,000, 3300 and 415 volts. D-c power is provided by rectifiers.

Steam for process and heating at Troste is supplied by ten 150-psi boilers, each of 15,400 lb of steam per hr capacity, fired with chain grate stokers.

At the Trostre plant, water is obtained through a 24-in. main from public reservoirs located about four miles from the plant. Since water is also recirculated here, a parabolic reinforced concrete cooling tower is provided, capable of cooling 250,000 gphr from 98 F to 78 F.



Heavy machine bay of the central repair shop, located between the Abbey and Margam works.

A central building 300 ft × 330 ft, located between the Abbey and Margam works, houses maintenance shops. One bay is devoted to rolling stock and locomotive repair, and contains 13 tracks equipped with pits, jacks, portable platforms, etc., as needed. The next bay houses a boiler shop and welding department, both containing modern equipment of the latest type. The third bay contains light machine tools grouped according to their types, but with consideration of the most frequent sequences of operations. The heavy machine shop, located in the fourth bay, is similarly arranged and also contains a well equipped tool room. The last bay houses the material storage, pipe shop and blacksmith shop.

A railroad track runs across the end of each bay, while overhead cranes, mobile cranes and jib cranes facilitate the handling within the shop.

In all phases of production, every effort is made to increase efficiency and quality. Chemical laboratories at Abbey and Margam works are well equipped, and are connected by pneumatic tube conveyors to strategic points in the producing departments. A central laboratory provides facilities for research and for training junior chemists. The metallurgical department is set up to check on raw materials, to control quality and yield through the manufacturing processes, to develop new steels and new applications, and to render customer service.

Mention should be made of the unusual construction of mill buildings. A uniform design was adopted, using high-and-low flat roofs, with transverse glazing in the drops in the roof. Deep vertical windows, curved over at the top, are placed under each low roof level. The steel work is all welded, and aluminum trough decking is used on the roofs. Siding is of No. 18 gage corrugated sheeting, heavily galvanized and painted inside and out.

Time-Tested COOPER Split ROLLER BEARINGS

"At the Steel Company of Wales we installed over 600 Cooper Split Roller Bearings on the basis of proven performance."

Cooper Split Roller Bearings are highest quality roller bearings with the ADDED feature of being *split right down to the shaft.* The split feature permits the application of anti-friction bearings where it would be impractical or impossible to mount solid ball or roller bearings.

The split feature does not limit the use of Cooper Bearings. Many applications are made where a solid bearing would be adequate. In such cases, the selection of Cooper Bearings is based on a proven record of dependability and long life. Cooper applications are world-wide and industry-wide.

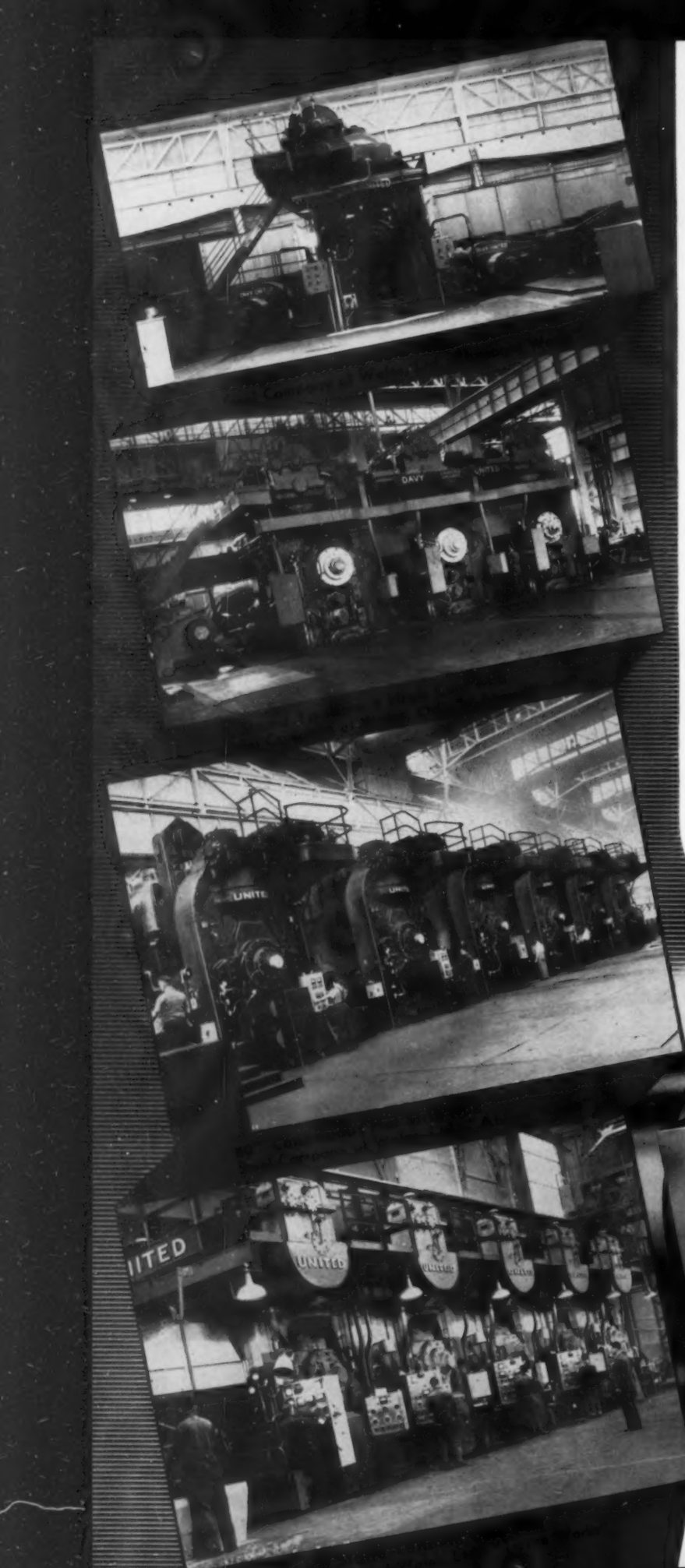
A broad range of dimensions and load capacities is available to suit the majority of applications. Cooper's modern facilities can provide special designs in minimum time.

SPLIT DOWN TO THE SHAFT

Write today for new illustrated catalog of complete line.

COOPER SPLIT ROLLER BEARING CORP.

702 CEDAR BOULEVARD • PITTSBURGH 28, PENNSYLVANIA



BRITISH STEELMAKERS depend on MORGOIL Roll Neck Bearings

because they
insure accurate products
last a long time
require little maintenance

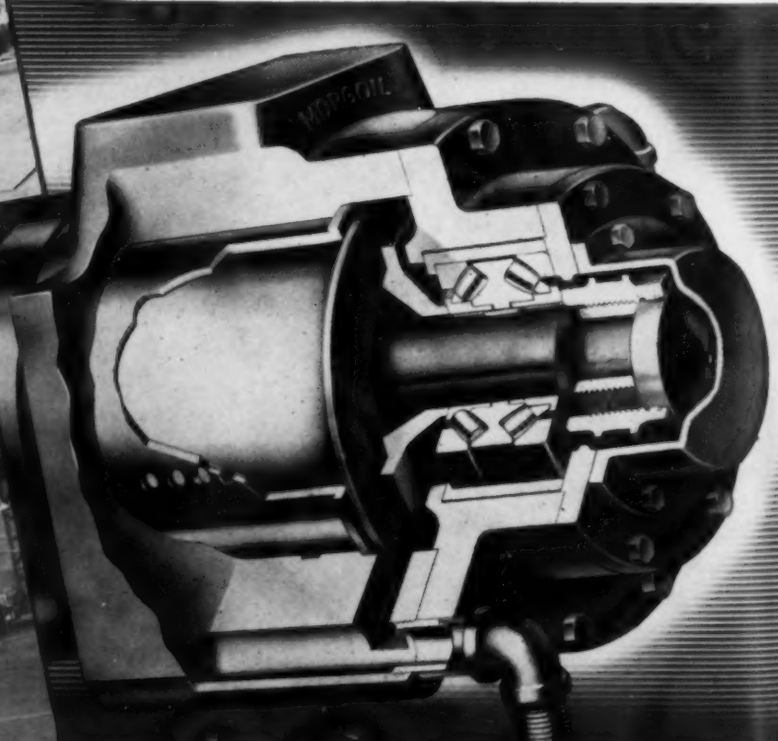
May we tell YOU more about them?

MORGAN CONSTRUCTION CO.
WORCESTER, MASSACHUSETTS

English Rep., International Construction Co., 56 Kingsway, London W. C. 2, England

ROLLING MILLS • MORGOIL BEARINGS • WIRE DRAWING MACHINES
REGENERATIVE FURNACE CONTROLS • EJECTORS • GAS PRODUCERS

MB-25



MORGOIL
ROLL NECK BEARINGS

LARGE ELECTRIC FURNACE OF THE FUTURE MAY BE SIX-ELECTRODE UNIT

By FRANK W. BROOKE

Pittsburgh, Pa.

▲ AN address recently presented to the Association of Iron and Steel Engineers on the subject of "Modern Open Hearths vs Electric Furnaces Present and Future" by Frank W. Brooke, inventor of the Swindell top charge 3-electrode furnace, gave a brief reference to a design of the probable large electric furnace of the future.

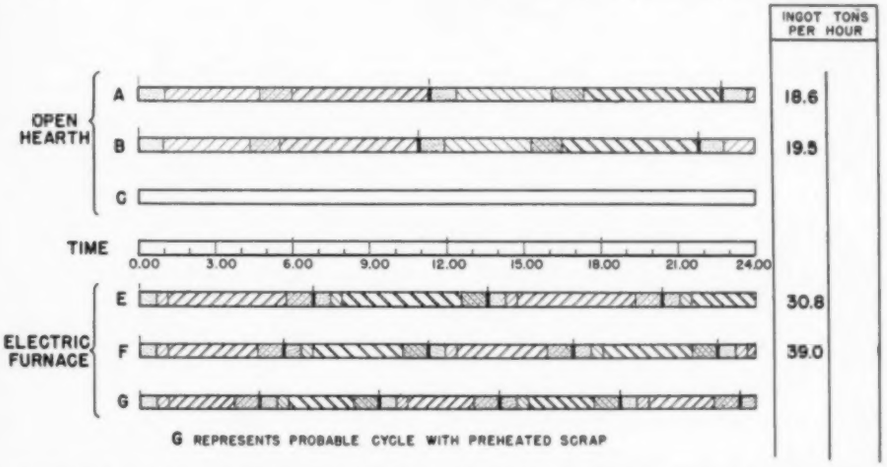


Figure 1 — Rate of production of 240-ton capacity electric furnace and open hearth are compared with these bar charts.

This paper will be printed in a later edition of the Iron and Steel Engineer. This article expands and supplements the above paper, and gives a more detailed description of the design of a future large electric furnace which could properly infiltrate into the open hearth field for plain carbon steel.

Such an electric furnace should have a capacity of 240 tons so that, by infiltration, one open hearth melting unit at a time could be removed and replaced with a complete electric furnace unit having the same holding capacity, but a much greater rate of production, (see Figure 1). This could be done at a cost of approximately $1,000,000 each.

It would seem that only in this way can such items as the great hazard of invested capital and others be overcome.

The first and most important decision to arrive at would be: Can or should a furnace of this size follow the present trend of large top charge electric furnaces by still further increasing the three electrode circular design or go to a six electrode oval design.

The race among the furnace builders and users has recently been one of who can build the largest three-electrode top charge electric furnace? There was a somewhat similar race in the open hearth field some 45 or 50 years ago when an open hearth furnace of 75 to 100-ton capacity was considered to have a top rating.

Then came duplexing methods in which the amount of steel poured into the ladle was only a portion of the total charge, and for which tilting open hearths where desirable. This was the beginning for larger and larger furnaces and size quickly increased to capacities of 200, 300, 400 and 500 tons.

It is therefore very interesting to note that during World War II, new

Figure 2 — This is an old view of Timken's metal shop which shows three 100-ton open hearths and one 100-ton, 6-electrode electric furnace. Open hearths are no longer in operation and have been replaced by electric furnaces.

open hearth plants had ratings of 240 tons, while since the war, at such plants as the Fairless Works, the Jones and Laughlin South Side Works and others, the furnaces are also the same capacity of approximately 240 tons. This indicates that the most up-to-date thinking of a large group of experienced management and engineers have arrived at a rating of 240 tons as the best overall rating to suit the maximum number of plant and production conditions. Based on this background, the author has a feeling that the 20 to 22-ft-0-in. diameter electric furnaces are the best top sizes for the three electrode, electric top-charge furnace.

Electric furnaces of 24-ft-0-in. and 24-ft-6-in. diameters are now being built and will soon be installed.

Some 20 years ago the Timken Steel Co. installed three 100-ton open hearths and one 100-ton 6-electrode, door charged, electric furnace side by side. (See Figure 2.) Quite recently the three open hearths were taken out and replaced by modern three electrode top charge electric furnaces, but, the six electrode electric furnace stayed in and continues to produce at its top rate, although it is still door charged and under capacity electrically—by the standards of modern practice.

The operating department of this company is wholly in accord with the opinion that from an operating and production point of view — other things being equal—it gives better performance than any of their three-electrode furnaces.

Now why has not this design been more recognized by the furnace builders and users?

The following are some of the reasons for this based on modern practice:

1. It is not a top charge design and the whole heat of 100 per cent cold scrap has to be charged into one door only.

At least one firm studied the possibilities of converting the design to a top charge by such means as a split roof, or a back tilt to the roof, and a simultaneous forward tilt to the furnace. They also prepared scale models but none of these met the requirements of modern top charge practice.

2. The electrical input by modern standards is insufficient.
3. Trouble has been and still is experienced in maintaining the front side wall. Part of this is due to the necessary large charging door and part to the fact that any electric melting furnace should be able to tilt 40 degrees for proper draining which is quite an angle for any "vertical" wall.
4. A further reason may be that operating figures were not to the authors knowledge available.

Figures 3, 4, and 5 show a design which will overcome the major objection of item one above in which the

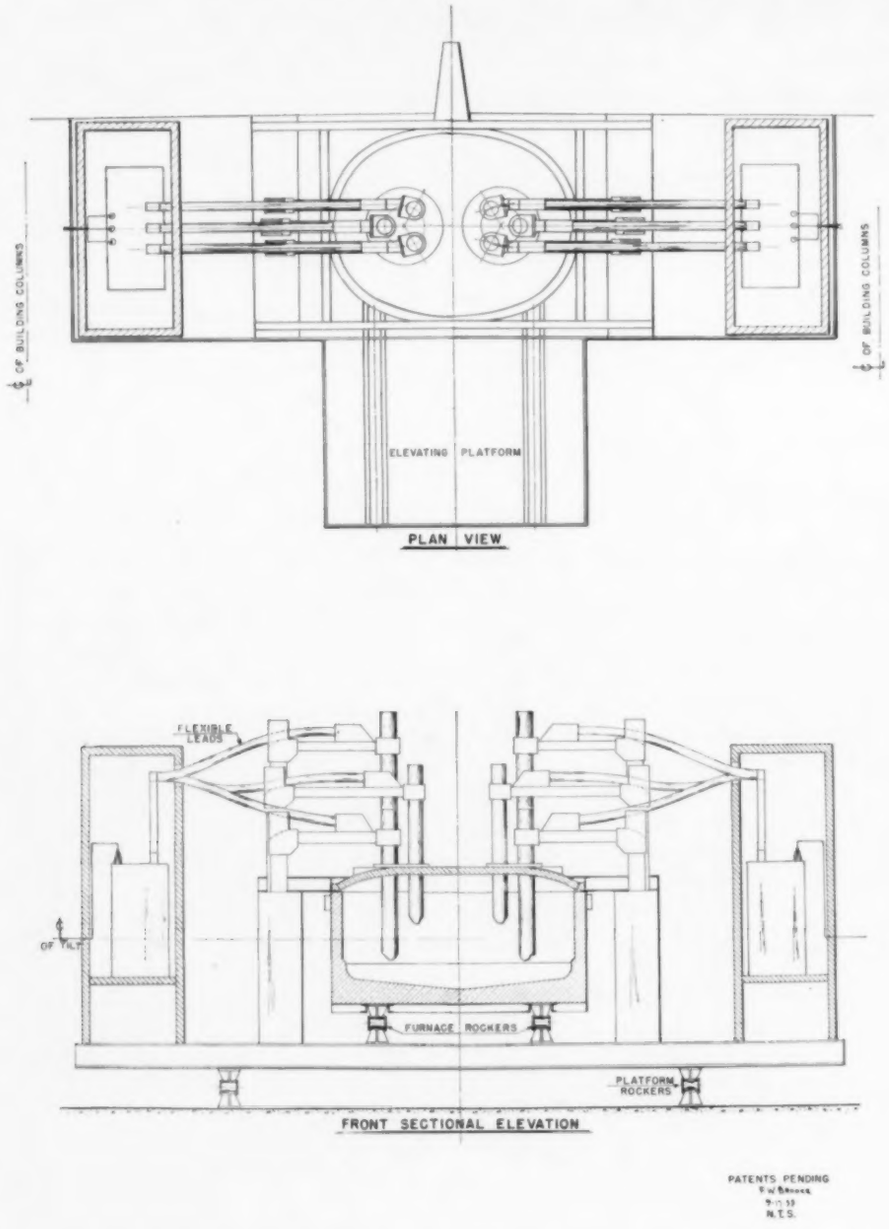


Figure 3 — Front elevation and plan shows design of a modern 6-electrode, top-charge electric furnace.

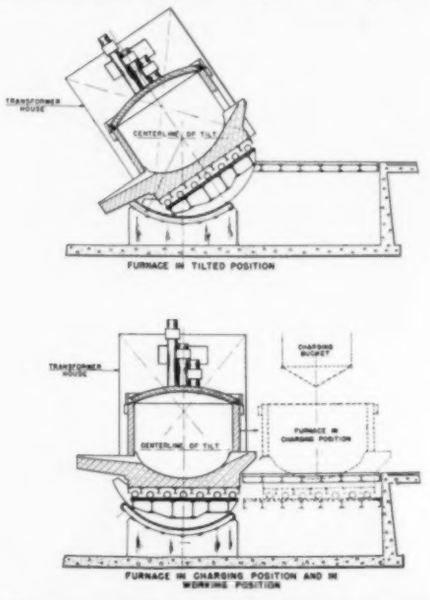


Figure 4 — End sectional elevations shows the furnace in its charging position and its tilting position.

TREADWELL

CINDER CARS

IN USE AT THE

STEEL COMPANY OF WALES, LTD.

GREAT BRITAIN

400 CUBIC FOOT AIR DUMP CAR

BUILT BY

HEAD, WRIGHTSON, LTD.

THORNABY ON TEES, ENGLAND

TO

TREADWELL DESIGNS AND SPECIFICATIONS

M. H. TREADWELL CO., INC.

208 S. LA SALLE ST.
CHICAGO 4, ILL.
CEntral 6-6704

140 CEDAR STREET
NEW YORK 6, N. Y.
WOrth 4-3344

1526 FARMERS BANK BLDG.
PITTSBURGH 22, PA.
ATlantic 1-8000

HEAD, WRIGHTSON, LTD., Thornaby on Tees, England

How Oxygen...and LINDE SERVICE*

SAVE TIME AND MONEY

CONDITIONING STEEL —150 TIMES FASTER!

LIN-DE-SURFACER SCARFING MACHINES use oxygen and acetylene to remove scale and surface defects from steel right on the roll line. This outstanding LINDE development conditions steel up to 150 times faster than manual methods.

LINDE Oxygen Customers get the advantage of...

LINDE'S MANY PLANTS, strategically located to assure a dependable supply, meet every demand. No oxygen failure due to failure of a single plant.

LINDE'S DRIOX and CASCADE Oxygen Systems, which have no fixed capacities. Even under widely fluctuating demands, your supply is determined by your needs. You pay only for what you use.

LINDE'S FIELD ENGINEERS, who work on oxygen users' problems —help them find new and better ways to get the most economy and efficiency from their use of LINDE oxygen.

LINDE'S LABORATORIES, which are constantly working on new and improved applications for oxygen. Many of today's oxygen-using methods and machines are the result of LINDE research and development.

If your company uses oxygen, LINDE SERVICE *can mean dollar savings to you. Let us tell you more about it.*

LINDE AIR PRODUCTS COMPANY

A Division of UNION CARBIDE AND CARBON CORPORATION

30 East 42nd Street UCC New York 17, N. Y.

Offices in Principal Cities

In Canada: Dominion Oxygen Company, Limited, Toronto

AND * LINDE SERVICE

which is the unique combination of all of the research, engineering, and over 40 years of accumulated know-how that is helping LINDE customers save money and improve production in their uses of oxygen and oxy-acetylene processes.

Linde Trade-Mark

top charging is accomplished in the manner shown in Figure 5.

Figure 5 shows a scale model in a charging position in a space such as is now occupied by a modern 240-ton open hearth furnace, and it is interesting to note that the overall length of the furnace with its two transformer houses, coincides almost exactly with the overall length of the open hearth including its burners, so that no change in the span of the columns would be necessary.

The width of the furnace and its pouring spout position has the same advantage and no change in the ladle position would be needed.

There is plenty of room available within the columns of the building referred to above to easily more than accommodate the highest transformer rating now in use.

In order to properly hold such a wall when using a magnesite brick lining, each row of bricks should have a definite tie to the steel shell of the furnace and an overall tie in of brick to brick. Such a wall construction has all the virtues of a metal-case construction and many new and unique features.

What would be the outstanding advantages of this furnace which would allow it to follow the pattern of infiltration which was so successful in the "door-charge versus top-charge" furnaces?

1. The probable reason why a large six-electrode furnace gives better melt-down and refining results is, that in furnaces of each design having the same holding and electrical rating—in the three electrode type—the total heat input in Btus into the charge has to be dispersed from three centers only, which have of necessity to be as close together as possible, while in the six-electrode design there are six such centers and a greater area for this dispersion.

2. Swinging the roof; the superstructure; arms; holders and several thousands of pounds of electrode (all at temperatures ranging from room temperature to 3000 F with a wide range of rates of expansion) from one pivoting point, remote from the center of a 24 ft-0 in. electric furnace, is a very serious problem of design. Even our very large swinging bridges are at least at a uniform temperature.

In the six-electrode design shown, there is, first of all, no such great out of center load to contend with, and secondly the weights of all the superstructure, electrodes, etc., are each only one-half the weight at each point of lift.

This factor alone would greatly reduce many designing difficulties and the maintenance cost, and because of the lower inertia of the moving parts, the regulation would be proportionately speeded up.

Figure 5 — Scale model shows how the furnace moves out to its charging position.

Figure 6 — This transformer can be tilted in any position from vertical to horizontal.

3. The principle of removing the furnace from under the roof for top charging has many years of background behind it, and would fit into the picture of an open hearth shop very much better than a swinging roof type, and the starting and stopping problems of the heavy lined shell as against the heavy roof and all its superstructure would be materially reduced.

4. Perhaps the most important is the practical elimination of the long looping flexible secondary leads from the transformer secondary leads (above the closing of the delta) to the electrode holders. These cannot be interlaced and have a high reactance value.

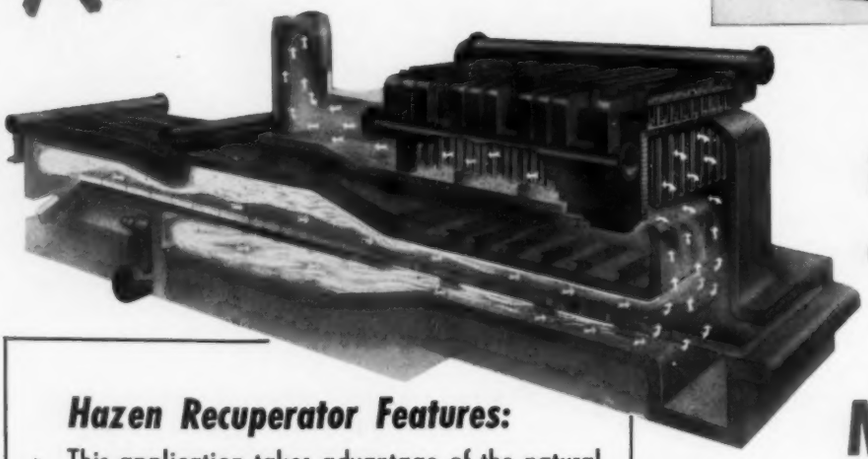
The designer of a large electric furnace has to constantly fight the overall impedance (reactance plus resistance) value of the electrical system, and has to resort in many cases to the use of expensive alloy members and other details. This value goes up in a ratio of the square of the current and is the principal reason for the use of high secondary voltages now in use. Avoiding any high technical explanations, if this problem is not properly taken care of, then the ratio of the kwh into the steel to the kva input falls below an economical value and irrespective of any other factors, it is kwhr (Btus) that *we can get into the steel* which defines the rate of melting. High voltages, high currents as shown on the control board, in themselves have nothing to do with it.

The design of the secondary leads in this furnace are unique because among other things they have a reactance value of only 25 per cent of the long looping leads now in use, and figures indicate that they will permit up to 10 per cent more kwhr to go into the steel for a given kva.

What is equally important is that

HAZEN FURNACE RECUPERATOR

the only 100% American Metallic Recuperator



100% Protection on Service!

Hazen Recuperator Features:

- This application takes advantage of the natural upward flow of flue gases.
- Less stack draft is required.
- Greater percentage of flue gases reach recuperator.
- Increased preheat . . . due to availability of a larger percentage of flue gases at higher temperatures.
- Economies in initial cost . . . by reducing the required amount of excavating and furnace foundation.
- Further economy . . . by reducing the length of flue ordinarily required from furnace to stack.
- Greater accessibility for ease of cleaning.
- Walkways may be provided around the recuperator for convenience of inspection and cleaning.
- Recuperator, flue and stack may be supported from steel work independent of the furnace bindings.
- Recuperator may be applied above an existing furnace with a minimum loss in outage time.

Made of American steel and alloys . . . by American labor . . . for meeting American high performance standards

Consult us about improving the production and economy of your furnace operations

HAZEN ENGINEERING CO.

PARK BLDG., PITTSBURGH 22, PA.

TELEPHONE COurt 1-7030

3

Figure 7 — View shows position of flexible cables and the heat they are subjected to during charging.

these long leads are not only bottle necks, but they are the principal headaches of the maintenance departments and have to be almost looked upon as expendable items, while the shutdown for repairs and replacements is a very serious item.

Why are they so long?

1. Because of the up-and-down travel of the electrodes.

2. Because of the tilting of the furnace *against a stationary transformer*. The normal tilting range is 40 degrees forward and 15 degrees backward.

3. Because of the swinging roof for top charging.

The first item seems to be unavoidable.

In the second item it occurred to the author that if the *transformer could tilt* with the furnace, the greatest per cent of the length would be eliminated. The problem was to find a design of transformer which would tilt 15 degrees forward and 15 degrees backward with the power on, and 40 degrees forward with the power off without any danger of oil leakage.

Figure 6 shows a large transmitter type Westinghouse oil filled transformer designed for (shipping purposes) to tilt through any range from vertical to horizontal, but there was still the problem of absolute safety from leakage through the secondary leads of an electric furnace type transformer.

Thanks to the excellent cooperation of the designing and commercial divisions of this company, they tackled the problem and came up and produced an outlet which they will back up for any steel works conditions.

The third problem is caused by the swinging of the roof for charging and Figure 7 gives some idea of what the designer is up against to avoid excessive lengths of the cables.

The reason for the high maintenance is best shown in Figure 7 which shows the bad atmosphere the leads are subjected to, especially during the charging and the early part of the melt down. It requires a colored photo to show the true condition. It is such that the low hanging portion of the flexible leads which have the outer heavy rubber-crank casing are actually scorched in spite of the heavy rate of water cooling inside the casing. This would be eliminated with the design shown.

And finally the question of available overhead will be an all important part in the replacement of open hearth units by electric furnaces.

During the infiltration period of the door charge versus the top charge furnaces, there was invariably two conditions of overhead clearance which had to be met.

The first was to obtain sufficient crane hook height to allow the drop bottom bucket to clear the sides of the furnace, and the second and more difficult one, was to get the necessary clearance height from the operating floor to the underside of the crane rail during the tilting period.

In the six-electrode furnace, being a combination of two three-electrode furnaces of half the capacity, it is easy to see why this overhead requirement will be very much less, especially for the electrode clearance during tilting. It is not generally realized, and difficult to explain without a diagram, that for each one foot increase in the height of the furnace shell, there has to be a corresponding two feet increase in the travel of the electrodes.

Another interesting factor in the ratio of the furnace shell diameter to the holding capacity of the furnace is that the holding capacity for a three-electrode furnace increases approximately in the ratio of $(\text{diameter})^{2.5}$, while in a six-electrode furnace it increases in the ratio of

$$\frac{(\text{length} + \text{width})}{2}^{2.5}.$$

A study is being made of a design which would still further materially reduce the clearance requirements from the furnace platform to the underside of the crane rail. This description of the six-electrode electric furnace has been restricted to a 240-ton capacity because as explained in the address in detail, it would be required to be this size to best infiltrate into the large open hearth plain carbon steel field in our most modern open hearth plants.

This type and design of furnace will, however, undoubtedly find itself to be the best and most economical one in the whole range of furnace capacities from 100-ton capacity—such as the capacity now in use at the Timken Steel Co.—up to any top size capacity which the future may develop.

Complete electrical specifications of transformers, regulator, breakers, etc., detailed open hearth and electric furnace production sheets; the future power situation, the possibilities of preheating and how this design will fit into the open hearth versus electric furnace picture was described in the paper of the 1953 AISE Annual Convention together with the many, many advantages which the electric furnace has so rapidly acquired during a very short recent period.

LOW FREQUENCY INDUCTION COILS SHORTEN BILLET HEATING TIME

. . . . this laboratory demonstration opens new vistas in the heating of steel . . .

▲ A new method which may substantially speed the heating of steel for rolling was set up for the experimental use of Pittsburgh district steel producers by West Penn Power Co., the General Engineering Co. of Toronto, Ont., and Geco Inc., Cleveland, at the utility's substation in Uniontown, Pa.

Figure 1 — An 8 x 8 x 30-in. steel billet is lifted from the experimental unit as it reached a uniform 2200 F temperature throughout, after 20 minutes inside the 60-cycle induction heating coil. An engineer is taking radiation pyrometer reading of the surface temperature while thermocouples buried inside the steel record internal temperatures.

Through the use of electrically powered coils, various size steel billets are brought from room temperature to rolling temperatures (about 2300 F) as much as five to ten times faster as in methods generally used. This was shown in a demonstration on October 1 attended by a Pittsburgh group. Continuing demonstrations and experimentation is scheduled for the first half of November when engineers and operators from various Pittsburgh steel plants will try the method out on their own billets.

At the demonstration, a 13 x 13 x 30 in. billet was heated to rolling temperatures with an efficiency of 80-85 per cent based on the ratio of heat in the kwhr input to the increased heat in the billet. This was done in less than one hour. A smaller 8 x 8 x 30-in.

Figure 2 — R. S. Segsworth, director of research, General Engineering Co., Ltd., of Toronto, Ontario, stands at the controls of the largest low frequency induction heating coil yet built. Water flowing through the copper tubing of the coil keeps the outside cool, as the 13 x 13 x 30-in. billet inside starts to heat. In less than an hour, the billet reached rolling temperature. Extruding flanges at top are for handling the billet, since no ingot or billet handling crane is available in the laboratory.

BIG

MANIPULATOR

Alliance MANIPULATOR
INCREASES PRODUCTION FROM 200 TO 400%

This 75-ton Alliance Manipulator is the world's biggest. It handles ingots for ship shaftings . . . press columns, large naval gun barrels and other huge jobs.

At the International Nickel Company plant in Huntington, West Virginia, two 4-ton straight line Alliance Manipulators serve a single hammer . . . forging Monel metal ingots from 14"x14" down to 8"x8". They helped boost 8 hours' production to 250% of the former record capacity with less than half the number of men.

Alliance builds forging manipulators in capacities from 1 to 75 tons in the following types . . . straight line trolley only, straight line trolley with bridge, sluing trolley type, sluing trolley type with bridge and crane type. Some bridge type manipulators handle the entire job—charging, forging, discharging and delivering.

Users of Alliance Machine Company Manipulators report 200 to 400% increased production with a smaller crew.

If you are not using Alliance Manipulators now, you can increase production and save money by writing us today.

THE *Alliance* MACHINE COMPANY

Main Office: Alliance, Ohio

LADLE CRANES · GANTRY CRANES · FORGING MANIPULATORS · SOAKING PIT CRANES
STRIPPER CRANES · SLAB AND BILLET CHARGING MACHINES · OPEN HEARTH CHARGING MACHINES · SPECIAL MILL MACHINERY · STRUCTURAL FABRICATION · COKE PUSHERS

Give Us The Runway And We'll Lift The World

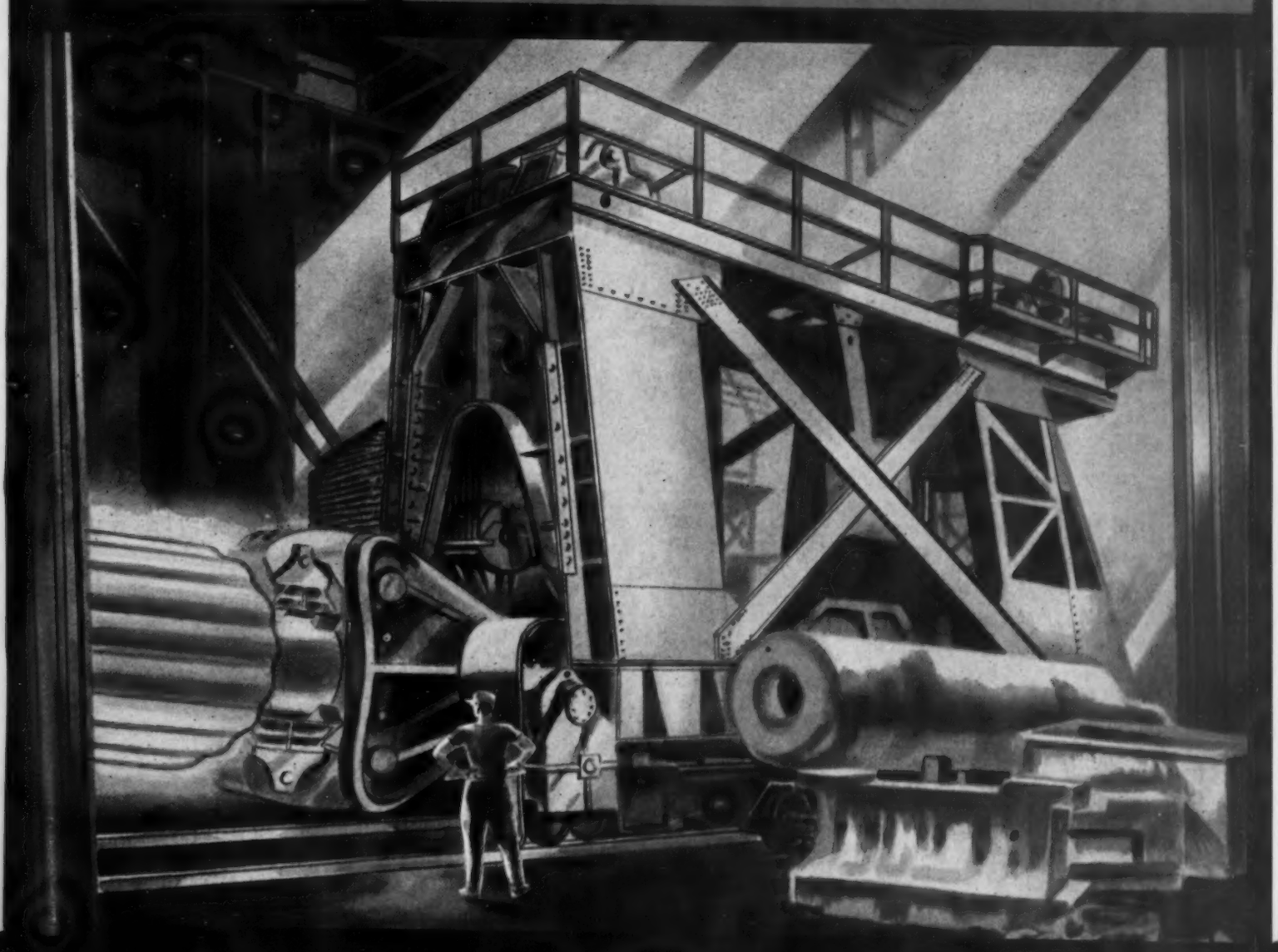


Figure 3 — In the demonstration test, readings were taken at three-minute intervals by automatic instruments to record the power input into the heating coils, and also the temperature changes within the billet being heated. Engineers plot the readings on graphs which are projected on the wall.

stainless billet was heated in 20 minutes with about the same efficiency.

Heating was done on induction heating equipment furnished by General Engineering Co., Ltd., consisting of one 13 x 13 x 30-in. coil, one 8 x 8 x 30-in. coil, and one 6 x 18 x 30-in. coil.

In addition, a model unit dual-frequency continuous billet heater for 2 x 2 x 18-in. bars was demonstrated which combines 60-cycle and 1000-cycle heating coils.

Recording instruments connected to the low-frequency units were used for both the thermocouple and radiation pyrometer operation.

Although low frequency induction heating has been used with non-ferrous metals, and for limited sizes in steel forgings and other processing, this is the first time that experimental equipment has been provided for 60-cycle heating of steel billets ranging in size up to 13 x 13 x 30-in. and weighing as much as 1500-lb.

Coils used to heat the steel are made of small copper tubing through which water flows to keep the units cool.

When a billet is placed within a coil and current is applied, heat is induced, or generated, within the steel itself. In the customary steel heating practice, heat is applied to the surface of the billet and must travel inward by conduction—a process requiring several hours in the case of big pieces.

To generate the heat, standard 60-cycle electricity at 460 volts is applied to the coils. This differs in two important respects from high-frequency induction heating which is widely used in heat-treating small parts and the surfaces of large items. First, no frequency conversion equipment is needed. Also, heat can be induced at a greater depth in the metal.

To permit steel producers to experiment with induction heating, the Canadian firm and West Penn Power Co. set up instruments to measure power input and to progressively record temperatures at various locations within the steel being heated.

If this new method can be developed for tonnage production in mills, it should offer the advantage of lower installation cost, ease of control, cleanliness of operation, and a reduction in space required. In addition, scale losses should be materially reduced because of the shorter time the surface of the steel is held at high temperatures.

These experiments are being arranged by director of research R. S. Segsworth of the General Engineering Co., Ltd., Toronto; and general industrial consultant M. R. McConnell, and industrial heating engineer C. H. Hartwig both of West Penn Power Co., Pittsburgh.

Figure 4 — A model production unit of a dual frequency billet heater shows how a 2 x 2 x 18-in. piece can be turned out continuously for processing. Bars pass first through a 60-cycle induction coil, then through a high frequency 1000-cycle coil which brings the stock up to the desired temperature. This method of heating lends itself to continuous processes.

New tapered bore TIMKEN® bearing in new midwestern mill has interference fit—yet is easy to remove

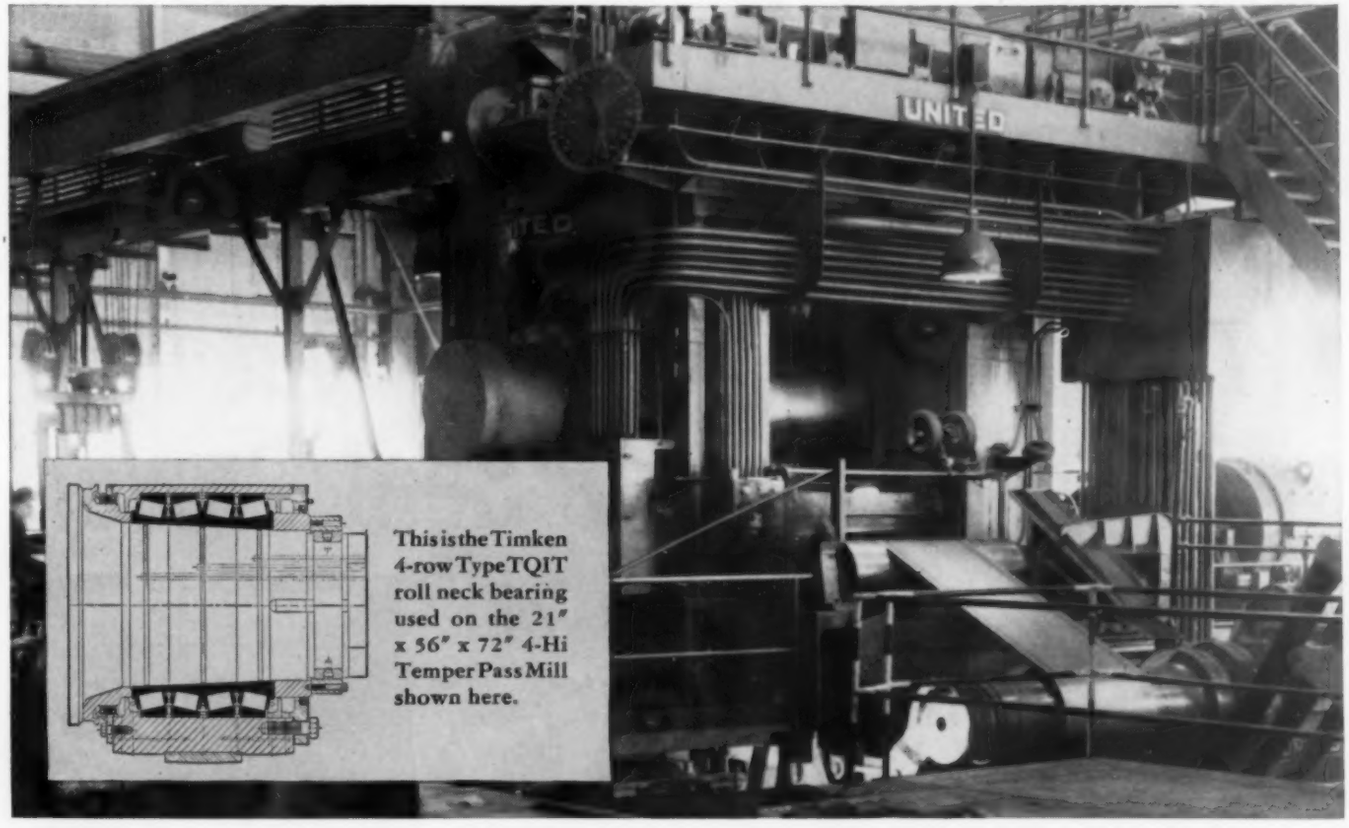
THE Timken TQIT bearing is the world's first 4-row tapered roller bearing with a tapered bore. It combines maximum bearing capacity and interference fit with easy removal. Now in service on a midwestern steel company's new 21″ x 56″ x 72″, 4-Hi Temper Pass Mill, this Timken® bearing has a bore of 32.625″, an O.D. of 45″, and a width of 32½″.

This bearing can be quickly removed from the roll neck by expanding its cones hydraulically. Excessive scuffing and neck wear are eliminated. The interference fit cone provides greater stability between the cone and the neck. It also gives better load distribution not only between the four rows of rollers in the bearing but also to the various rollers within each row. This easily serviced installation permits improved fillet contours and larger necks. Result: lower neck stress and deflections than any other arrangement that can be used.

Of course, like other Timken roll neck bearings, this new tapered bore Timken bearing permits maximum roll neck size and greater mill rigidity. It also eliminates the need for special thrust bearings and makes possible higher rolling mill speeds. Mills can be stopped and started without the loss of steel.

Always specify Timken bearings for the machines you build or buy. Look for the trade-mark "Timken" stamped on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.

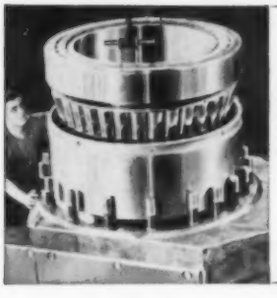


This is the Timken 4-row Type TQIT roll neck bearing used on the 21″ x 56″ x 72″ 4-Hi Temper Pass Mill shown here.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

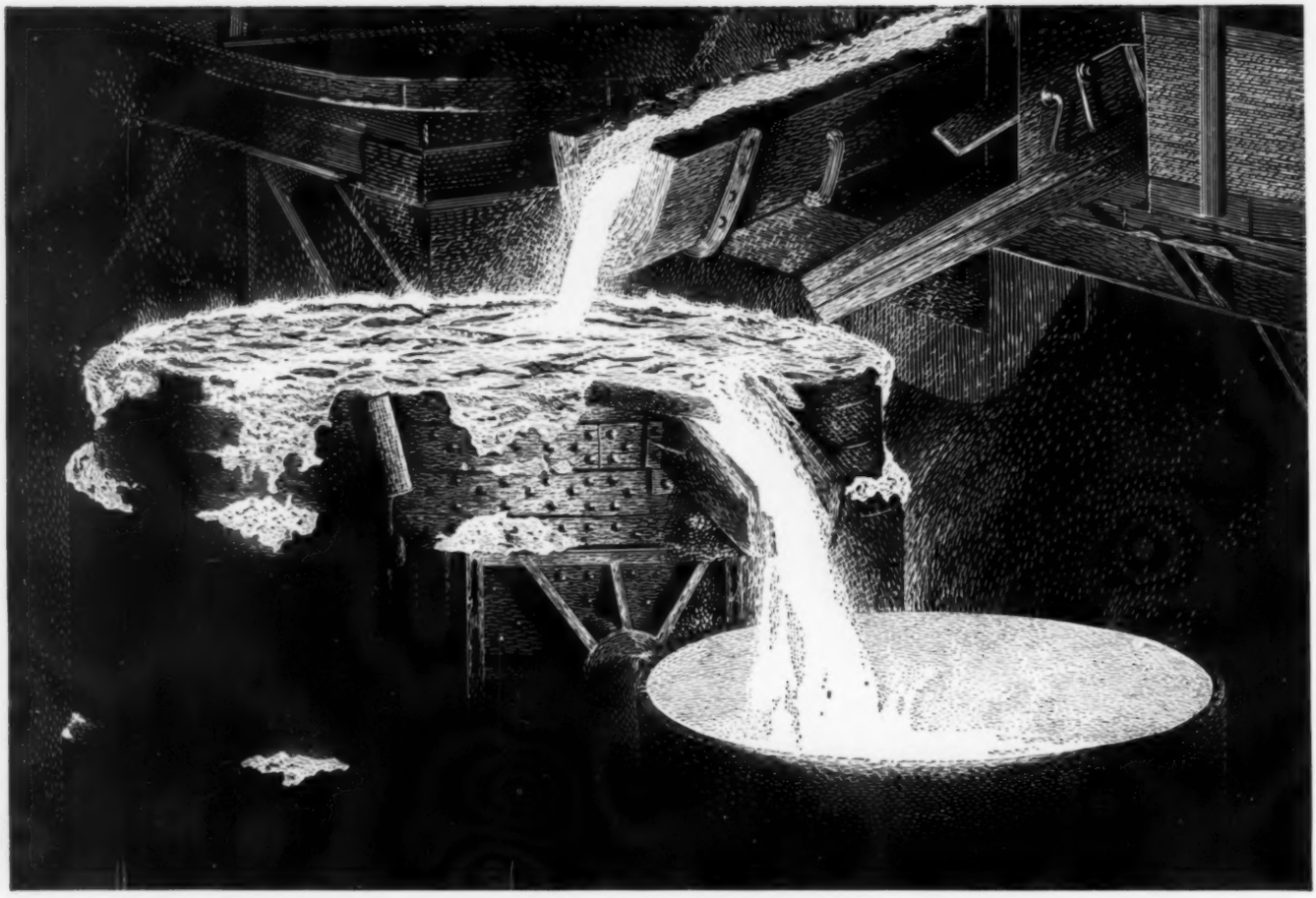
TAPERED ROLLER BEARINGS



ROLL NECK BEARING ENGINEERING SERVICE

Our field and service engineers have had years of experience with problems of roll neck bearing design and operation. They'll help you select bearings and design mountings. The Timken Roller Bearing Company is the acknowledged leader in: 1. advanced design; 2. precision manufacture; 3. rigid quality control; 4. special analysis Timken steels.

NOT JUST A BALL ◯ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭ BEARING TAKES RADIAL ↓ AND THRUST →◫← LOADS OR ANY COMBINATION



A top steel producer reports increase:

From 220 to 330 tons per day with Cities Service Heat Prover!

Tap-to-tap time reduced from 18 hours to 12 hours! . . . Fuel cut 5%! . . . Tonnage up 50% daily! That's the amazing job the Cities Service Heat Prover helped perform for one of the country's biggest steel producers.

They were running a batch size of 165 tons, with a tap to tap time of 18 hours, using 400 gallons of fuel per hour. After the Heat Prover readings were translated into actual readjustments, TAP-TO-TAP TIME WAS CUT TO 12 HOURS, ALLOWING TWO FULL BATCHES EVERY 24 HOURS INSTEAD OF EVERY 36 . . . AND FUEL WAS CUT TO 320 GALLONS PER HOUR!

Remarkable? Sure . . . and it's the kind of a job the Cities Service Heat Prover can do wherever a furnace operation is involved by providing:

• Rapid, continuous sampling • Simultaneous reading and direct measurement of oxygen and combustibles • Easy portability • No maintenance or recalibration.

For details, contact nearest Cities Service office or write Cities Service Oil Company, Dept. K11, Sixty Wall Tower, New York City 5, N. Y.

FREE—NOT AN INSTRUMENT YOU CAN BUY, BUT A SERVICE WE SUPPLY!

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

ECONOMICAL REFRACTORY BOTTOM DEVELOPED FOR REHEATING FURNACES

▲ ONE of the big problems of the builders and operators of continuous reheating furnaces is the means of supporting the heavy slabs during the trip through the furnace. This problem has become more complex as larger and heavier slabs must be heated to within exacting limits.

In the heating zone, water cooled skids have proven practical and frictional resistance has been kept at a minimum. Maintenance of these skids do not appear to present serious difficulty.

In the soaking zone, high tonnage rates has emphasized the importance and necessity of solid refractory hearth bottoms which have been the accepted means of supporting the slabs in the final stages of heating. Many materials have been tried for this purpose with varying and limited success. The most generally accepted material for the solid bottom or soaking hearth portion of the continuous furnace has been chrome ore mortar which is rammed into place. The principal objections to most of these materials have been initial cost, and the difficulty in maintaining, patching and replacement, as well as loss of production due to shut down time required for such repairs.

The Hyche method of building, maintaining, patching and replacing continuous reheating furnace bottoms uses materials which are comparatively cheap, readily available, and once properly installed, the bottom is permanent, as it lends itself to ease of patching. Holes or low spots can be filled without shutting a furnace down.

These materials are pig iron, mill scale, chrome ore dust and magnesite. The mill scale is predominantly Fe_3O_4. It has high compression strength at operating temperature, but softens and readily bonds to similar materials at temperatures in excess of 2400 F. The bottom offers a minimum of friction to steel slabs being pushed over the hearth and will accumulate less cinders under average heating conditions.

Magnesite is used primarily as a foundation material to prevent the molten material from running through the brick work and around skids pipes which go into the bottom. In furnaces with heat capacity high enough to fuse magnesite, it can be used to advantage in the mass.

The pig iron and mill scale become a heavy mobile fluid at temperatures above 2300 F. Not only is this material forced by gravity into voids, cavities and low spots, but as the pig iron oxidizes to Fe_3O_4 in the bottom, it increases in volume and compacts and solidifies the entire mass. Amalgamation results in a hard abrasion resistant monolithic bottom. Chrome ore dust is added as needed to increase the refractory quality of the bottom.

These bottoms were developed and patented about five years ago by J. H. Hyche. The method was immediately adopted by the steel company for which Mr. Hyche worked and has since been in continuous use in all of their furnaces with outages for repairs and upkeep greatly reduced. Except in case of complete rebuilding of one of three furnaces, these bottoms have been in constant use for more than five years and each one of them has handled over two million tons of steel.

The bottom can, with entirely satisfactory results, be applied over a badly worn plastic bottom, either as a whole bottom or patch, providing the supporting masonry is in good condition. The old bottom does not have to be removed. Neither does the furnace have to be cooled off. In fact that is how the method was discovered, since the experiments were chiefly patches. The savings in loss of production is large as new bottoms can be installed or patchwork done on down turns. The cost of labor and material used in these patches are nominal.

Stopping rust with Rust-Oleum 769 Damp-Proof Red Primer
... for double protection use Rust-Oleum finish coatings
available in many colors, aluminum and white

RUST-OLEUM®

STOPS RUST!

Applied by brush, dip, or spray.

Just scrape and wirebrush to remove rust scale and loose particles . . . then brush Rust-Oleum 769 Damp-Proof Red Primer *directly over the sound rusted surface.* Chemical pre-cleaning and other costly preparations are *not* usually required. Rust-Oleum finish coats in many colors provide *double protection.* Specify Rust-Oleum . . . prompt delivery from Industrial Distributor stocks in principal cities.

RUST-OLEUM CORPORATION
2441 Oakton Street, Evanston, Illinois

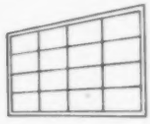
FREE SURVEY: Ask a Rust-Oleum specialist to conduct a survey including actual applications, tests, and recommendations. No cost or obligation. See Sweets for nearest Rust-Oleum distributor or write for literature today.

...proved throughout industry for over 25 years

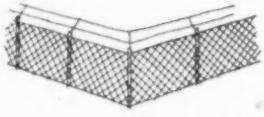
Such fields as Petroleum, Marine, Railroad, Mining, Agricultural, Steel, General Industry are but a few who rely upon Rust-Oleum. General weathering, heat, chemicals, salt water atmosphere, fumes, etc., are only a few of the conditions resisted by Rust-Oleum.

Water tanks, gas tanks, fuel tanks—Rust-Oleum protects your investment.

One truck, or a fleet of trucks, applied over rust, Rust-Oleum keeps them looking better . . . in service longer.



Metal sash and steel windows, roofs, gutters, fire escapes, railings—indoors and out need Rust-Oleum to stop rust.



Wire fence maintenance? Rust-Oleum's Extra-Long Nap Lamb's Wool Roller cuts re-coating costs up to 50% in some cases.

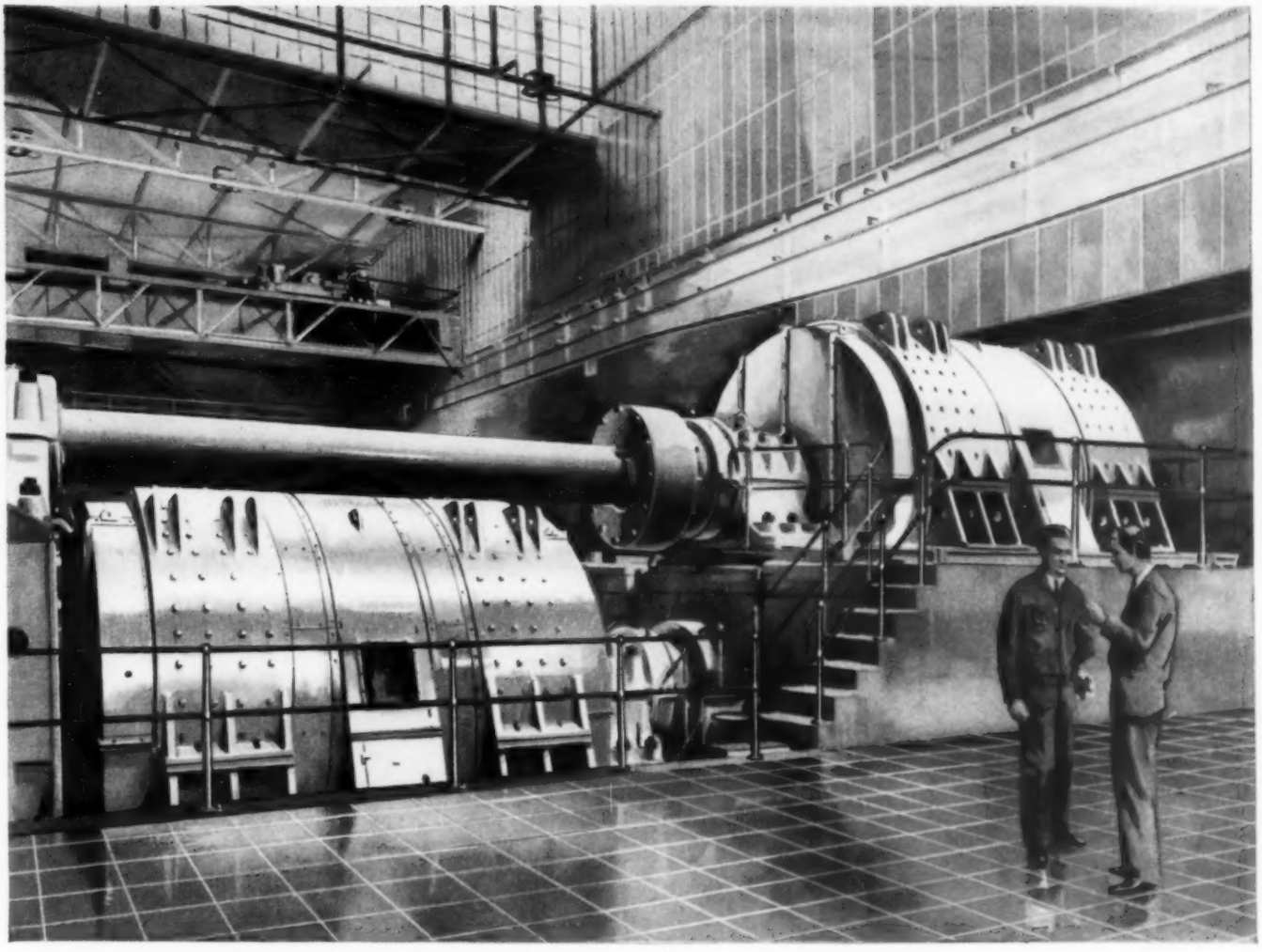
There is Only One Rust-Oleum

Rust-Oleum is an *exclusive formula* developed by a Master Mariner during more than 20 years battling actual rust conditions at sea. It incorporates a *specially-processed* fish oil vehicle that will *dry*, is *odor-free*, and is formulated in *many colors.* Be sure you specify genuine Rust-Oleum. Accept no substitute.

ATTACH TO YOUR LETTERHEAD-MAIL TODAY!

RUST-OLEUM CORPORATION
2441 Oakton St., Evanston, Illinois

- ☐ Have a Qualified Representative Call
- ☐ Free Survey
- ☐ Complete Literature
- ☐ Nearest Source of Supply



Modern rolling mill practice . . .

The twin drive, with each roll driven separately, thereby eliminating the pinion stand, was pioneered by 'ENGLISH ELECTRIC' as early as 1922. Shown here are the main motors of a double armature twin reversing drive developing 27,600 peak horsepower, for a 45 inch slabbing mill. The rapid acceleration and deceleration required is obtained by the 'ENGLISH ELECTRIC' standard reversing mill Control System, employing the 'ENGLISH ELECTRIC' Magnavolt rapid response control exciter.

The Company has supplied many drives for both hot and cold rolling mills, including over fifty main drives for hot reversing mills, as well as many other hot mill drives for continuous and semi-continuous strip, sheet, wire rod and merchant sections. Also, the long experience of 'ENGLISH ELECTRIC' in this field provides a wealth of information on all electrical problems . . . power and substations, cabling and ventilating and complete layouts.

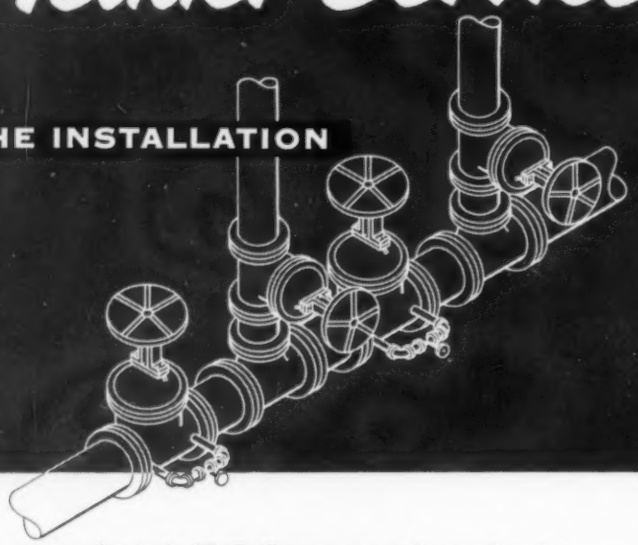
'ENGLISH ELECTRIC'

rolling mill drives

Offices in Halifax, Montreal, Ottawa, Toronto, Winnipeg, Calgary, Edmonton, Vancouver
English Electric Company of Canada Limited. Head Office and Factory: St. Catharines, Ontario

Holding Tight Since 1917 On Boiler Header Service

THE INSTALLATION



In power plant of a U. S. Government Arsenal, using Crane 14-inch 300-pound steel gate valves in main steam header operating at 135 pounds, 380 degrees F.

VALVE SERVICE RATINGS

SUITABILITY:	No failure in 36 years
FEATURES:	100% heavy duty design
MAINTENANCE COST:	No repairs to date
SERVICE LIFE:	Installed 1917—still O.K.
OPERATING RESULT:	Increased plant efficiency
AVAILABILITY:	Crane catalog item—Current No. 33XR

THE CASE HISTORY

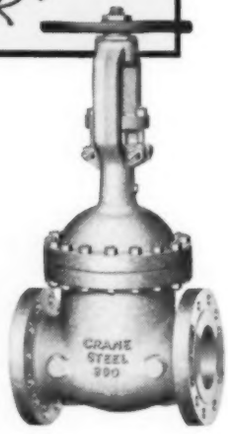
Installed in 1917, these Crane valves have given completely satisfactory service for 36 years without needing repairs of any kind. Inspected in 1951, they showed no undue wear in any part, and a 125-pound hydrostatic test found them absolutely tight. Right back into the header they went, where they're still giving like-new service.

In a period of plant expansion, other makes of valves were tried in the same header service. But those valves gave constant trouble, whereas when replaced with Crane valves, satisfactory results were obtained.

Here's an example of the confidence you can put in a name that traditionally means better quality. For what good is a price without the assurance of product dependability and good value. You're safer—always—when you choose Crane.

THE VALVE

Here is steel casting skill at its best, by the pioneer in steel valves. Here also is leadership in design and manufacturing that sets Crane Steel Valves apart from the ordinary. Choose these valves for your specific needs from the widest range of body and trim materials, in all pressure classes and sizes, with flanged, screwed, or welding ends. See your Crane Catalog.



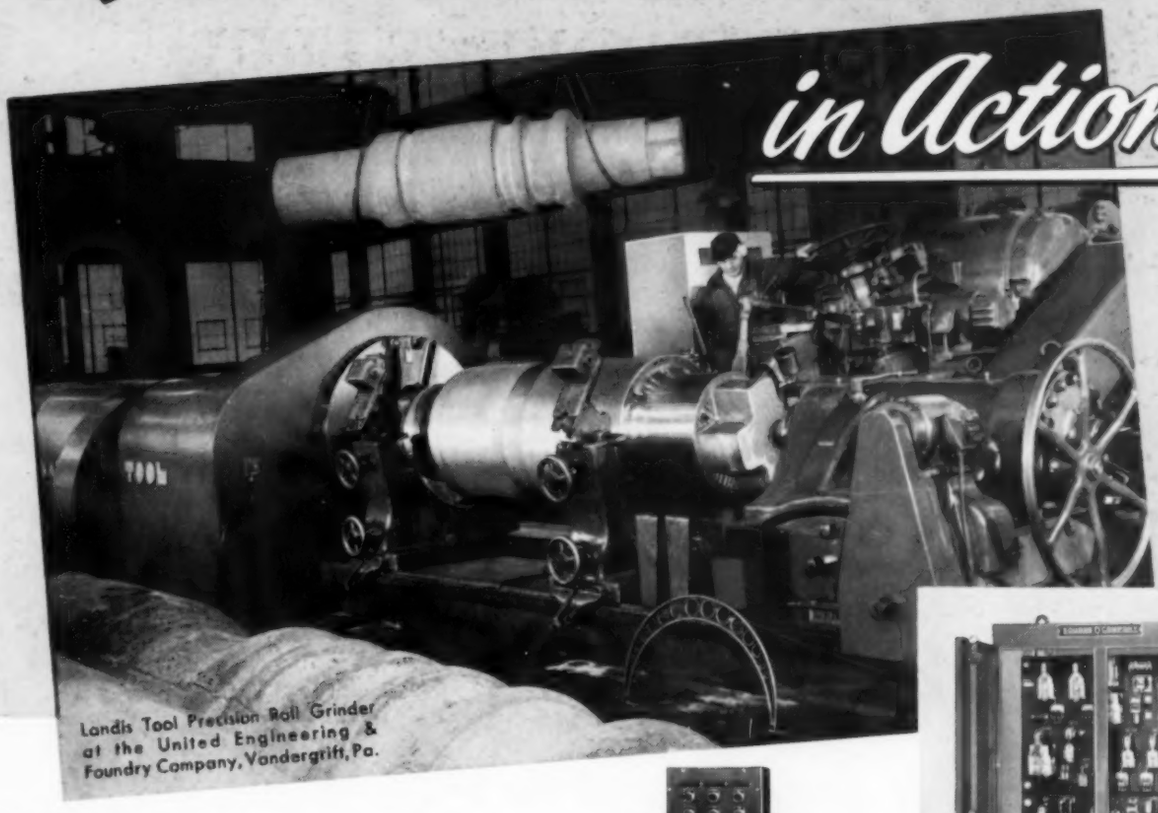
THE BETTER QUALITY... BIGGER VALUE LINE... IN BRASS, STEEL, IRON

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

SQUARE D FIELD ENGINEERING *in Action!*

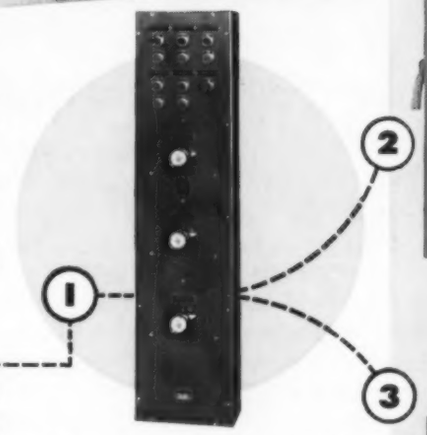


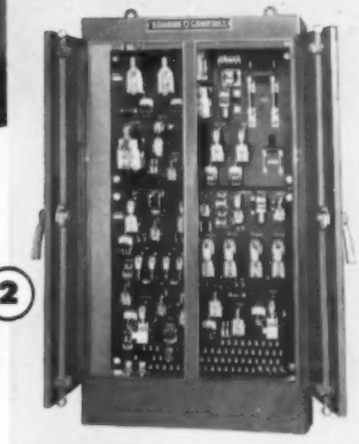
Landis Tool Precision Roll Grinder at the United Engineering & Foundry Company, Vandergrift, Pa.

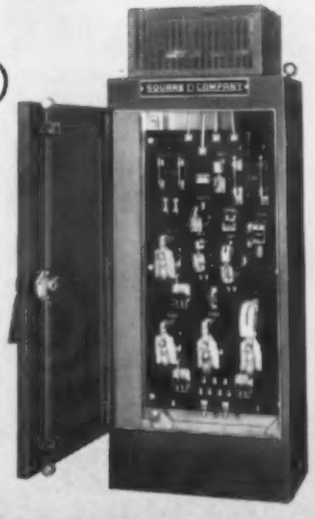
PROBLEM: To design an electrical control system for a Landis Tool 60" x 192", Type 30 roll grinder with eight D.C. motors.

Master control station on traveling carriage to control all functions.

No trailing cables between floor and carriage. Minimum number of trolley wires. Rigid space limitations on carriage mounted equipment.







SOLUTION:

Square D Heavy Duty D.C. Control Panel and Master Control Station on carriage with interlocked, floor-mounted control panel for work drive motor.

Control circuit developed with field switching feature requiring only 1 control trolley and 2 power trolleys. (Normally 6 to 8 trolleys would be required.) *All* floor-to-carriage flexible *cables eliminated.* Space limitations met without sacrifice of electrical clearances or protective features.

1. Master Control Station, mounted on traveling carriage.
2. Carriage-mounted Controller starts, accelerates and stops these motors: wheel drive, carriage traverse, ways lubrication pump, spindle lubrication pump, wheel in and out rapid movement, coolant pump.
3. Floor-mounted Controller for starting, stopping and speed control of work drive motor.

Square D Field Engineers Are at Your Service Through Branch Offices in All Principal Cities

SQUARE D COMPANY

1903 • 50 YEARS OF DESIGN LEADERSHIP • 1953

BLOOMING MILL BUILT FOR DETROIT STEEL

. . . . a new two-high reversing high lift 44 x 110-in. slab blooming mill was shown recently by the Morgan Engineering Company of Alliance, Ohio to a group of steel mill engineers. This mill was built for the Detroit Steel Corp.'s Portsmouth, Ohio Division. Scheduled production of the mill is set at 1,300,000 tons per year of slab and blooms consisting of 1,100,000 tons of 54-in. maximum width slabs and 200,000 tons of 6 x 6-in. to 12 x 12-in. blooms. The weight of the maximum slab ingot will be about 30,000 lb. . . . .

▲THE entire installation consists of the following machine units:

1. Front dump ingot buggy.
2. Ingot receiving table.
3. Overhead type ingot scale and ingot turning mechanism.
4. Intermediate mill table.
5. Two main mill tables.
6. Manipulator on entry and delivery side of mill.
7. 44 x 110 in. two-high reversing slabbing blooming mill.
8. Air hydraulic accumulator.
9. Intermediate delivery table.
10. Shear approach table.
11. Adjustable side guard mechanism.
12. 1200-ton slab and bloom shear.
13. Crop pusher.
14. Crop conveyor.
15. Slab and bloom shear gauge.
16. Shear pull back table.
17. Two transfer run-in tables.
18. Slab and bloom transfer.
19. Furnace run-in table.
20. Disappearing stop.
21. Tilting type slab piling table.
22. Slab pile transfer car.
23. Slab pile tow car.
24. Lubrication systems.
25. Roll changing machine.
26. Mill operator's pulpit.

The mill is of the two-high reversing high lift type and is driven by two 4000-hp, 40/100 rpm General Electric motors, capable of delivering an "every ingot" torque of 2,362,500 lb-ft and an emergency torque of 2,887,000 lb-ft.

Rolls are 44-in. diam x 110-in. long body, provided with 62-in. wide slabbing or bull head pass in addition to 14, 8 and 6-in. bloom and edging passes. Roll necks are 26-in. diam operating in fabric type bearing 26-in. long.

Maximum top roll lift is 16 in.

Top roll, top spindle and bottom spindle are balanced hydraulically by means of three cylinders having chromium plated plungers. The three balancing cylinders operate at 600 psi furnished by an air hydraulic accumulator system complete with pump and air compressor.

Screws are 15-in, diam, 2-in. pitch, with hardened threads and are operated by two 150-hp, shunt wound, 460-rpm 600 series, mill type motors. Screws operate at a speed of 200 ipm with motors operating at normal running speed of 460 rpm and will operate at a maximum speed of 400 ipm through adjustable voltage control.

Screw down drive mechanism consists of gear reduction and cone type worm and worm gear drive. Entire drive is of totally enclosed construction, all revolving elements are roller bearing mounted and are lubricated by means of a circulating pressure oil lubricating system.

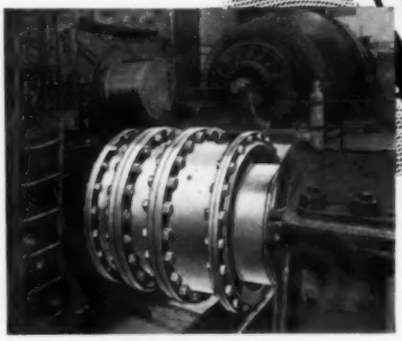
Screw down worm shaft is provided with a hydraulically operated clutch. This arrangement permits the operation of both screws in unison or, when desired, one screw may be operated independent of the other to permit easy, quick and accurate alignment of the rolls by remote control.

Two revolving dial indicators for registering the relative position of the rolls are provided with selsyn motors and are located in operator's pulpit. Both indicators are operated from screw down worm shaft through proper gear reduction, and two selsyn generators.

Main drive spindles are of alloy forged steel, 20-in. diam and 30 ft long from center to center of universal couplings. Couplings are provided with high tensile bronze slippers.

Each spindle is provided with individual hydraulic balance and oper-

(Please turn to page 144)



This 30" Bore Fast's Coupling is on the main drive of the blooming mill at a large Eastern steel mill . . . one of many Fast's linking power to production at this installation.

For SAVINGS up to $30,000 per hour... FAST'S Couplings are FIRST!

A coupling failure in the steel mill installation shown here would cost this mill $30,000 for every hour of down-time! That a Fast's Coupling was selected for this vital spot is striking testimony to the reputation for rugged dependability Fast's Couplings have enjoyed through the years. And Fast's guarantees *you* the same protection against costly shutdowns, whatever your coupling applications!

Remember: Fast's Couplings give you *rugged construction* . . . the original design has been maintained without basic change or sacrifice in size or materials. Fast's Couplings give you *lowest* cost per year . . . *Fast's usually outlast the equipment they connect.* And Fast's Couplings give you the benefit of Koppers *free engineering service* . . . assuring you of the right coupling for any job and the right solutions to tough coupling problems.

For full details on how Fast's Couplings and Koppers Engineering Service can help you insure uninterrupted power transmission, write today for your free copy of our catalog to: KOPPERS COMPANY, INC., *Fast's Coupling Dept.,* 311 Scott Street, Baltimore 3, Md.

KOPPERS®

THE ORIGINAL

FAST'S Couplings

METAL PRODUCTS DIVISION • KOPPERS COMPANY, INC. • BALTIMORE, MD. This Koppers Division also supplies industry with American Hammered Industrial Piston and Sealing Rings, Koppers-Elex Electrostatic Precipitators, Aeromaster Fans and Gas Apparatus.

Engineered* Products Sold with *Service

KOPPERS COMPANY, INC., *Fast's Coupling Dept.*, 311 Scott St., Baltimore 3, Md.

Gentlemen: Send me a Fast's Catalog giving detailed descriptions, engineering drawings, capacity tables and photographs.

Name .....

Company .....

Address .....

City ..... **Zone** ..... **State** .....

HERE'S A STORY EVERY PLANT OPERATING MAN SHOULD READ

"Heating in our main switch was causing Shutdowns But we stopped them cold by changing to Fusetron dual Element Fuses"

"In the Fall of 1951 in our cafeteria, we installed a new 1200 ampere switch. This switch controlled the lighting, refrigeration and a 115 ton air conditioning load.

"Everything was fine until the temperature reached 85 degrees and the summer air conditioning load came on. Then we had trouble.

"Three times in May, 1952 during our noon rush our whole place was shutdown.

"Our dining rooms seat 500 people at a time, so you can see what a shutdown during the noon rush means to us.

"We were fighting mad about the whole affair as the installation was practically new. Mr. Menees of the Arkansas Power and Light Co. was called in.

"He suggested that the trouble was due to the adding of the summer temperature to the normal heating of the fuses. Then he recommended that we discard our ordinary fuses and install FUSETRON dual-element fuses, as these modern fuses operated at a much cooler temperature than other fuses.

"This we did. To date, June 19, 1953, over one year since we made the change we have not had a shutdown due to a fuse blowing even though today's temperature outside is over 100 degrees.

"The cooler operation of FUSETRON fuses stopped shutdowns cold for us."

C. A. Franke, President
Franke's Inc., Little Rock, Ark.

FRANKE'S CAFETERIA in Little Rock, Arkansas, feeds several thousands of people daily. It is one of the oldest and best known eating places in the state and travelers have carried the fame of its fine food throughout the Nation.

Left: Mr. C. A. Franke, President, Franke's Inc.

Right: Mr. Bruce Menees, Industrial Engineer, Arkansas Power & Light Co.

You too, can profit by the 10 POINT PROTECTION of FUSETRON dual-element FUSES

1 *Protect against short-circuits.

2 Protect against needless blows caused by harmless overloads.

3 Protect against needless blows caused by excessive heating—lesser resistance results in cooler operation.

4 Provide thermal protection—for panels and switches against damage from heating due to poor contact.

5 Protect motors against burnout from overloading.

6 Protect motors against burnout due to single phasing.

7 Give DOUBLE burnout protection to large motors — without extra cost.

8 Make protection of small motors simple and inexpensive.

9 Protect against waste of space and money — permit use of proper size switches and panels.

10 Protect coils, transformers and solenoids against burnout.

*Fusetron Fuses have high interrupting capacity as shown by tests of the Electrical Testing Laboratories of New York.

FUSETRON is a trademark of the Bussmann Mfg. Co., Division of McGraw Electric Co.

FUSETRON

TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION

BUSS

FOR MORE INFORMATION *use this Coupon*

BUSSMANN Mfg. Co. (Division of McGraw Electric Co.)
University at Jefferson, St. Louis 7, Mo.

Please send me complete facts about FUSETRON dual-element Fuses.

*Name*_____

*Title*_____

*Company*_____

*Address*_____

*City & Zone*_____ *State*_____ 1153

Figure 1 — This 44 x 100-in., two-high, reversing, high-lift, slabbing-blooming mill was built for the Detroit Steel Corp.'s Portsmouth, Ohio Division.

(*Continued from page 140*)

ates in two bearings, fabric lined, supported on two carrier beams. The two carrier beams for each spindle are supported on a separate stand at the motor end, and are connected to their respective balancing cylinders at the mill end.

Mill is equipped with four feed rollers, two rollers on each side of the mill. Feed rollers are steel forgings, 20-in. diam x 110-in. body length. Roller necks are 9½-in. diam provided with roller bearings, three to each neck, mounted in cartridges. Inside feed roller cartridges are mounted in tapered bores of roll housings for easy removal of feed roller assembly.

Each pair of feed rollers is driven by one 50-hp, 550 rpm motor, flexibly connected to a spur gear reduction drive located on the drive side of the mill. The reduction drive is connected to the feed rollers through universal couplings. The drive gears for the "inside" feed rollers are of a friction type mounting, capable of absorbing the excessive impact loads to which the inside feed rollers of reversing mills are subjected. The speed of the feed roller is adjustable and synchronized with the speed of the mill rolls through voltage control.

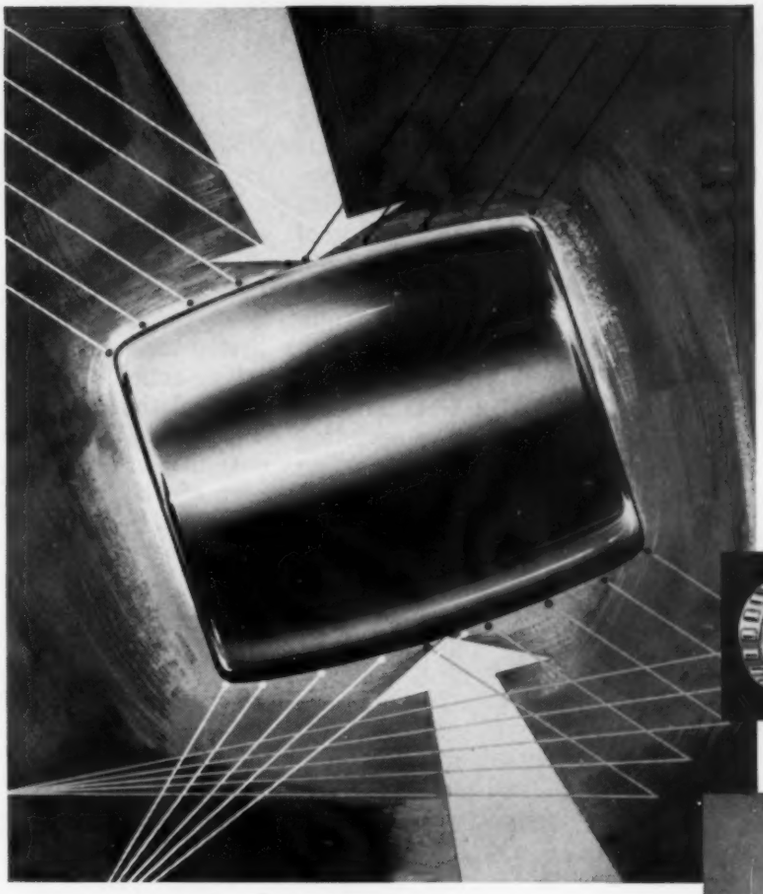
A motor operated roll changing mechanism has been provided for removing both rolls and bearing chucks from the mill in one operation. The entire roll assembly rests on a bottom roll bearing cradle which is slidably mounted on suitable slide ways provided at bottom of roll housing windows and roll housing separators. All sliding surfaces are completely covered and guarded against exposure to scale. The roll changing machine is of the screw and traveling nut type, is operated by a 25-hp, 650-rpm motor connected to a worm and worm gear reduction drive. The entire mechanism is located in a floor plate covered trench in line with the longitudinal axis of the mill. The machine has a travel stroke of 18-ft-0 in. and a travel speed of 6 ft-0 in. per minute.

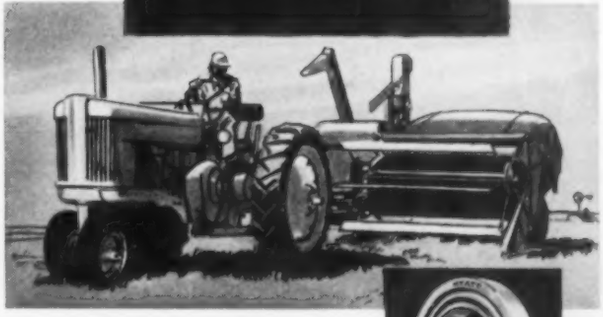
The ingot buggy is of the front dumping type, electrically driven and operates at variable speeds up to a maximum speed of 800 fpm through variable voltage control.

The car body is of cast steel and welded steel construction and is mounted at the front end of a four wheel—two axle truck and on the other end on a two wheel driving axle with 33-in. diam wheels. All axles are operating in anti-friction bearings.

The car is driven by a 100-hp forced air cooled, 485 rpm shunt wound motor. The entire drive unit, including the motor and brake, is mounted on a three point suspended car type drive base which affords quick and convenient installation or removal of the entire driving unit.

The ingot pot is of cast steel construction, mounted on heavy trun-





A new era in bearings is taking this shape...

NEW HYATT BARREL BEARING

now available in volume!

Industrial designers and engineers seldom make changes in bearing specifications. But when they discover something *really new*—like Hyatt's BARREL BEARING—out come the blueprints! *And this time they know they've got something!* Hyatt's new Barrel Bearing combines dual-purpose design with self-aligning action. It takes load from any direction and operates at full efficiency under conditions of misalignment! And, because barrel-shaped rollers provide high load capacity with low friction, this unique bearing is ideal for a wide range of applications. Best of all, the *cost* is far lower than you would expect! Find out how to improve *your* product . . . Consult a Hyatt Sales-Engineer, or write for our new Barrel Bearing catalog.

HYATT ROLLER BEARINGS

STRAIGHT · RADIAL · TAPER

HYATT BEARINGS DIVISION • GENERAL MOTORS CORPORATION, HARRISON, N. J.

nion bearings. The pot is tilted by means of a double crank drive cone type worm gear unit connected to a 75-hp, shunt-wound, 515 rpm motor. Two adjustable engine type connecting rods connect the cranks to the ingot pot.

The car frame is designed to accumulate the scale and slag from the ingot on its travel from the soaking pits to the ingot receiving table in order to keep the car runway free from scale obstructions. The accumulated scale and slag in the car frame will be automatically discharged into the scale pit of the ingot receiving table by the tilting motion of the ingot pot. This is accomplished by an opening and closing trap door device which is a part of the car body.

The ingot scale and ingot turning machine is of the overhead type and is located approximately 20 ft from the end of the ingot receiving table. The function of this machine is to weigh and record the weight of the ingots and to provide means of turning the ingot through 180 degrees thereby enabling the mill operator to enter the ingot into the mill with either the small or the big end of the ingot leading.

The machine consists chiefly of a structural welded steel structure spanning the ingot receiving table and forms the support for both the lifting drive weighing and the ingot turn-around mechanism.

The ingot lifting and weighing mechanism consists of three forged steel stirrups, located between and three inches below the top of the table rollers. The stirrup assembly is connected to a rotating cylindrical stem which is carried on an anti-friction type thrust bearing mounting in a guided lifting frame. The lifting frame is connected by chains, levers and shafting to a lifting drive powered by a 35-hp, 475-rpm motor which lifts the ingot 14 in. above the top of table rollers. The ingot will be weighed in this elevated position by a 50-ton capacity Fairbanks, Morse and Co. suspension scale connected to a cabinet dial with chart graduated 50,000 x 50 lb. Dial is fitted with "Printomatic" having a printing range of 50,000 lb x 50 lb. Recording is done on a double roll tape, one of which to wind up inside the recorder case; the other to feed out through a slot in the case. The printomatic is fitted with solenoid release for automatic operation from a limit switch installed on the ingot lifting mechanism.

The ingot turn-around mechanism is powered by a 10-hp, 800-rpm motor which is connected to a spur and worm gear reduction drive mounted on the guided lifting frame. This drive revolves the ingot on the stirrup assembly in its up-position through 180 degrees by means of a gear mounted on the cylindrical stem.

The control for the weighing and turning of the ingot is fully automatic and follows the following sequence:

Ingot to be weighed and turned:

1. Ingot is lifted off the table.
2. Ingot is automatically weighed in up-position.
3. Ingot is automatically turned through 180 degrees.
4. Ingot is automatically lowered on table.

Ingot to be weighed only:

1. Ingot is lifted off the table.
2. Ingot is automatically weighed in up-position.
3. Ingot is automatically lowered on table.

The two main mill tables are of massive construction to sustain the heavy impact loads which are imparted to the table structure by the rolling action of the mill and by the manipulation of heavy slab ingots. The tables are designed to accommodate an electric overhead manipulator of the retracting type. Each table is 25 ft-10 in. from center end to end roller, containing twelve forged steel rollers 20-in. diameter x 110-in. body length. Necks of rollers are 9½ in. diameter operating in roller bearings, two to each neck, mounted in cartridges equipped with piston ring seals.

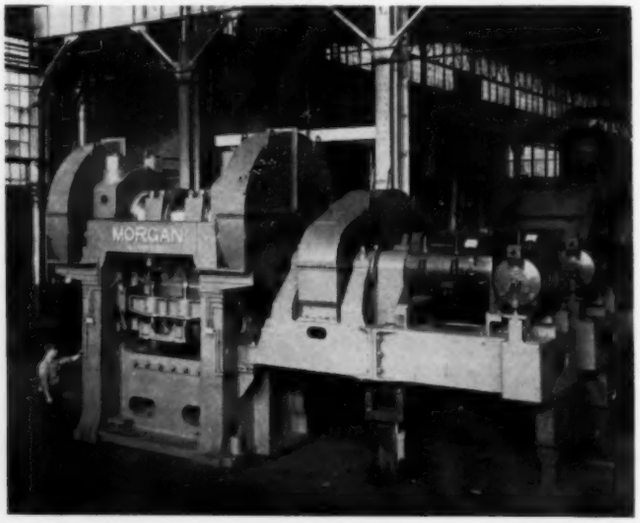
Rollers of each table are driven by two 150 hp 460 rpm shunt wound motors through gear reduction and mitre gear side shaft drive. Rollers operate at a speed of 450 fpm with motors operating at normal speed of 460 rpm and will operate at a maximum speed of 900 fpm through adjustable voltage control.

Side shaft is forged steel 8⅝-in. diameter and roller bearing mounted. A steep angle Timken bearing is provided for sustaining the thrust of the bevel gears. All gears have hardened teeth, are totally enclosed and are operating in oil. The mounting of table rollers and side shafts is designed to permit of independent endwise

(*Please turn to page 150*)

Figure 2 — This main mill table shows manipulator retracted.

Figure 3 — The bloom and slab shear is rated at 1200 tons.



FARRELL -CHEEK

ALLOY CAST STEEL WHEELS

A Tremendous Range of Types and Sizes

LAST 4 to 8 TIMES LONGER THAN ORDINARY WHEELS!

FARRELL-CHEEK STEEL CO.

HIGHEST QUALITY ELECTRIC FURNACE CARBON AND ALLOY STEEL CASTINGS

FARRELL'S CARBON STEEL CASTINGS

F-C HARD EDGE STEEL CASTINGS

F85 STEEL CASTINGS

RAILROAD CASTINGS Locomotive and Car R. R. Specialty Castings

ELEVATOR, CONVEYOR PARTS Sprockets, Traction Wheels, Chains, Buckets, Rollers, Idlers, Bushings.

GEARS AND PINIONS "True Tooth" Gears and Pinions, Sheaves and Wheels.

CRANE WHEELS Overhead, Gantry, Monorail, Ingot Car, Charging Machine.

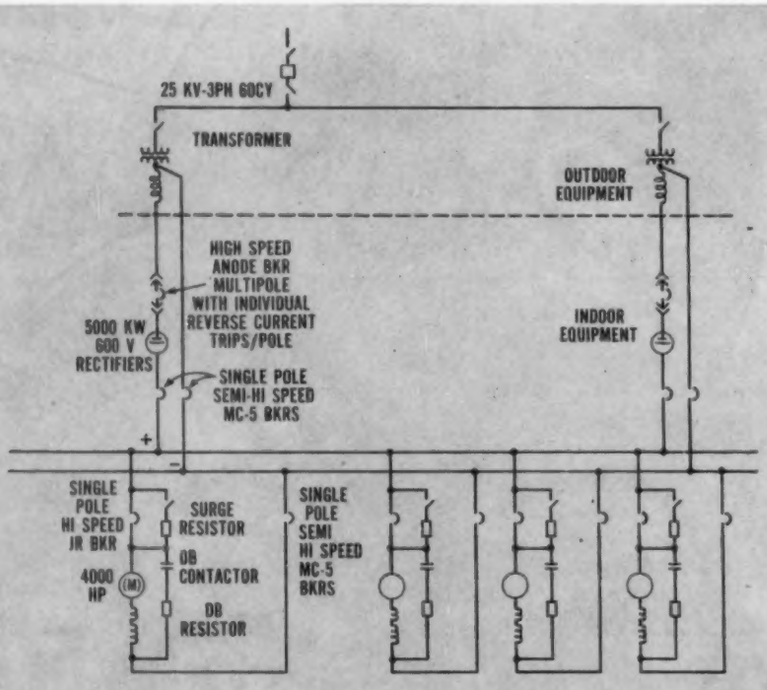
STOKER PARTS Feed Screws, Furnace Tools, Flanged Pipe, etc.

HEAVY HARDWARE Complete Line Wire Rope Fittings and Cutters, Bar Benders and Cutters.

YOUR INQUIRY WILL PROMPTLY BRING DETAILED INFORMATION PERTAINING TO ANY OF THE ABOVE FARRELL-CHEEK PRODUCTS

SANDUSKY, OHIO

FEW INSPECTIONS ARE NEEDED. Here, the motor room attendant checks vacuum of rectifier equipment. Maintenance is reduced because rectifiers have few moving parts. Further, since rectifiers are static, heavy foundations are not needed.

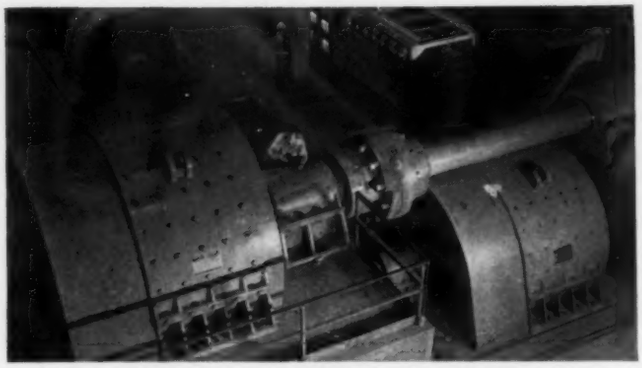


HOW THIS DRIVE WORKS

All motors are connected to a common 600 volt bus, supplied by two 5000-kw rectifiers. The voltage on this bus is held constant during rolling operations by amplistat-type voltage regulators, which combine accuracy and fast response with simplicity, dependability and low maintenance. The amplistat, as well as the rectifier ignition circuit, is completely static—no moving parts.

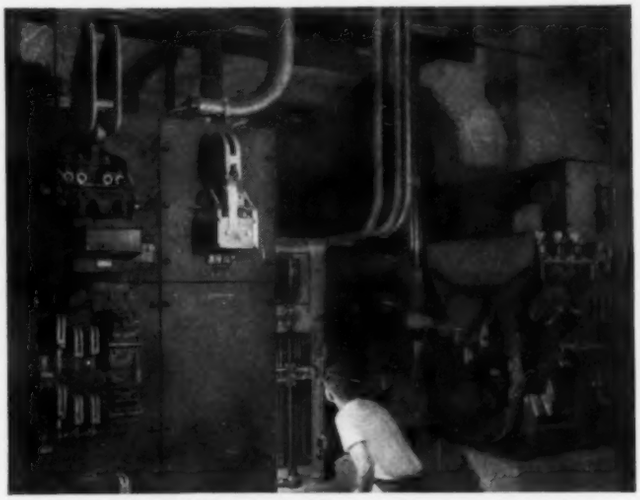
High-speed multipole draw-out type anode breakers are used to interrupt rectifier arc-backs and reclose automatically without interfering with continuity of power supply or voltage regulation. Additional fault current protection and flexibility of operation is provided by rectifier cathode and transformer neutral semi-high speed single pole breakers. High speed breakers with surge cushioning resistors and semi-high speed breakers insure a high degree of protection for the stand motors.

Another example of G-E drive engineering at work!

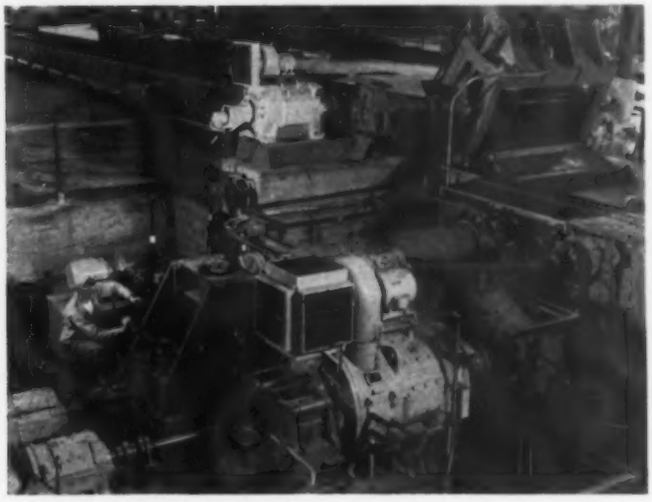


SLAB THICKNESS IS REDUCED 90% by a 4-high reversing rougher and vertical edger in five to seven passes. Twin 3000-hp motors drive mill; a 600-hp motor powers edger.

INDIVIDUAL RUNOUT-TABLE MOTORS—177 3-hp Type MDY's, specifically designed for this type of service, are part of 2500 horsepower of d-c auxiliary motors supplied.



CO-ORDINATED HIGH-SPEED Type JR and semi-high speed Type MC-5 breakers help safeguard against damage from flashover or overload of finishing train main drive motors.



COILER IS SPEED-MATCHED to last mill stand and runout tables. An improved tension regulator and a separate generator for the pinch roll help improve quality and increase tonnage.

Main drives of Pittsburgh Steel's new mill powered by G-E rectifiers

Part of complete G-E system, these efficient units power finishing train of 66" hot-strip mill

A highly efficient type of conversion system—using two mercury arc rectifiers—has been installed by the Pittsburgh Steel Company to supply d-c power for the finishing train of their new semi-continuous hot-strip mill at Allenport, Pa.

It's the third time rectifiers alone—controlled by magnetic amplifiers—have been used in the United States for such service. Two pumped rectifiers each rated at 5000-kw, convert power from 25,000 volts, 3-phase, 60-cycle a-c to 600 volts d-c. This power drives four G-E 4000-hp finishing stand motors. Strip 66 inches wide can be rolled at a present top speed of 1770 feet per minute.

The Allenport mill's rectifier system was patterned after a G-E "first" which has been in service for more than three years. These rectifiers, like the rest of the power equipment throughout the mill, were selected after careful engineering study. Engineers from Pittsburgh Steel, G.E., and United Engineering & Foundry teamed up to co-ordinate this electric equipment into one smoothly functioning system. These engineers also made provision for future expansion—two more finishing stands and an additional coiler can be easily added whenever needed.

If you are planning to modernize or expand any of your facilities, take a tip from Pittsburgh Steel. Call on G-E steel mill specialists early during the planning stage. General Electric Company, Schenectady 5, N. Y. 659-99

GENERAL ELECTRIC

(Continued from page 146)
movement for convenient disengagement of mitre gears when removing or installing rollers or side shafting.

Table beams are of heavy cast steel, box section construction. Drive side table beams are provided with integral oil trough which provides the oil reservoir for all driving gears. The table beams are rigidly spaced and cross tied by beam type cast steel separators, tongued and grooved at connecting surfaces and fastened by through bolts.

The manipulator is of the electric overhead retracting type, is located on the drive side of the mill and consists of two manipulator units, one on entry side of the mill, the other on the delivery side of the mill. The retracting type manipulator provides a stroke to the manipulator heads which is in excess of the normal required working stroke of 110-in. This construction permits the retraction of the manipulator heads from the tables and provides unobstructed accessibility to the mill tables.

The two manipulator units on entry and delivery side of mill are connected by drive shafts which synchronize the motion of the manipulator heads on either side of the mill.

Each of the two manipulator units is driven by two 150-hp shunt wound motors, connected in series operating at a normal speed of 230 rpm. The motor drives are geared to impart a speed of 210 fpm to the manipulator heads at normal speed of the motors. The speed of the heads is controlled through adjustable voltage control.

The manipulator unit on entering side of the mill is equipped with a finger lift ingot turning mechanism. This mechanism consists of a series of four fingers which are connected to levers mounted on two finger lift shafts. These shafts are operating in spherically mounted bearings located on the "inside" manipulator heads. The finger lift shafts are connected by suitable linkage to a double crank lifting drive of the cone worm and worm gear type, which is driven by one 100 hp 485 rpm motor. The fingers have a maximum lift of 37-in. above the top of table rollers and operate at a speed of 27 lifts per minute. The control for the lift travel is so arranged that the travel can be stopped or reversed at any point of the stroke. The entire finger lift mechanism is mounted on a cast steel girder base which rests on and is securely connected to the inside manipulator racks.

There are four manipulator racks for each manipulator unit which are provided with renewable hardened and cut rack teeth.

The shear is of the start and stop down cut type having a capacity of 1200-ton knife pressure. The shear is operated by two 350 hp mill type shunt wound motors of 375 rpm and is geared to obtain eight strokes per minute when operating at normal speed of 375 rpm of motors. The maximum number of cuts is 16 cuts per minute through voltage control.

The shear has a stroke of 14-in. and knives 64-in. long.

The bottom knife is mounted in the shear frame which is cooled by circulating water to counteract excessive heat absorption. A window has been provided in the shear housing to facilitate the changing of the knives by means of a special knife changing rig.

The shear drive is a separate unit which connects to the eccentric shaft of the shear by means of a universal coupling. The entire drive is of welded steel construction, and accommodates a double gear reduction which is spray lubricated by an integral pressure oil lubricating system.

A hydraulic gag has been provided on the entry side of the shear which receives the hold down pressure from the air-hydraulic accumulator system of the mill. Gag cylinder plunger is chromium plated to guard against corrosion and to prevent excessive wear of glands.

Shear gauge is of the overhead, screw and traveling nut type, electrically operated. The gauge is designed to gauge minimum length of 6 ft-0-in. and maximum length of 22-ft-0-in.

The gauge head is mounted on a traveling carriage which is slidably mounted on two slab girders. These girders are supported on a shear housing separator at the shear end and at the other end on a box type girder beam which spans the shear table. The gauge head is raised and lowered at a speed of 16 lifts per minute through a crank drive, driven by a 25-hp motor connected to a worm and worm gear reduction drive.

The position of the gauge carriage is adjustable at a speed of 14 fpm by means of a 12-in. diam screw and traveling nut. The screw is operated by a 35-hp motor connected to a worm gear drive mounted on the bridge girder.

The traveling nut is of special construction and special mounting in the gauge carriage which permits its replacement in a short time without the removal of the carriage or any other major operating part.

The slab piling equipment consists of a tilting type table, a slab pile transfer car and a tow car.

The tilting slab piling table is 20 ft-0 in. long consisting of eleven forged steel 14-in. diam rollers mounted on anti-friction bearings. Rollers are driven by a 100-hp motor at a maximum speed of 300 fpm with suitable control for speed adjustments down to 50 fpm. All drive gears are totally enclosed and lubricated by an integral oil circulating system.

Table is provided with motor operated side guards having a minimum opening of 22-in. and maximum opening of 64-in.

The table is trunnion mounted at one end and receives its tilting motion through a forged steel tilting shaft provided with lifting levers. The tilting shaft is operated by a vertical screw and revolving nut type drive which connects to a 50-hp 550 rpm motor. The maximum lift of the table is 48 in.

The slab pile transfer car is 20 ft-0-in. long and 13 ft-0-in. wide, capable of accommodating two piles of slabs of 54-in. maximum width.

The car body consists of two heavy cast steel box type girders which are joined together by three separators. The upper part of the car body is designed to receive twelve rolled steel slab grids, each 6-in. thick x 20-in. high and 13 ft long, which forms the support for the slab piles.

The car is mounted on four axles operating in antifriction bearings with wheels of 24-in. diam.

Tow car is connected to the slab pile transfer car by means of a coupler and moves the transfer car from the mill building to the slab conditioning building.

The car body consists of a heavy cast steel frame mounted on two axles operating in antifriction bearings. Each axle is driven by a 35-hp 575 rpm motor through double spur gear reduction drive which imparts a speed to the car of 160 fpm. The two motors are operated in series and by remote control.

BIRDSBORO

PORTABLE CROP SHEARS

This MOVE Cuts Time and Costs on Steel Cropping

Complete with electric motor drive and starter in a single unit, Birdsboro Portable Crop Shears can be quickly shifted by crane to any location where cropping is required. No need to lose a single bar for lack of shearing facilities at the right point.

These units, for rod and merchant mills, feature the same skill of design and engineering found in all Birdsboro Mill Machinery. They provide easy-to-operate centralized controls . . . fast positive cutting action . . . and performance that pays off in day-after-day profits.

If your mill operations call for cutting split and cold ends off steel bars, there's a time and money-saving advantage for you in Birdsboro Portable Crop Shears. A Birdsboro Engineer will work with you to help you get the results you want.

BIRDSBORO

STEEL FOUNDRY & MACHINE CO.

Birdsboro, Penna.

STEEL MILL MACHINERY

Designers and Builders of:

Steel Mill Machinery • Crushing Machinery • Rolls
Hydraulic Presses • Special Machinery • Steel Castings

MM-26-52

Offices in: Birdsboro, Pa., and Pittsburgh, Pa.

Service . . . where and when you want it

PROMPT, experienced service is one of the most important plus values you get when you buy Honeywell instruments. An unequalled organization of trained specialists is always at your call at more than 110 offices in the United States and Canada. Offices are located in practically every large industrial city of the country . . . close to every major production center.

Trained Personnel

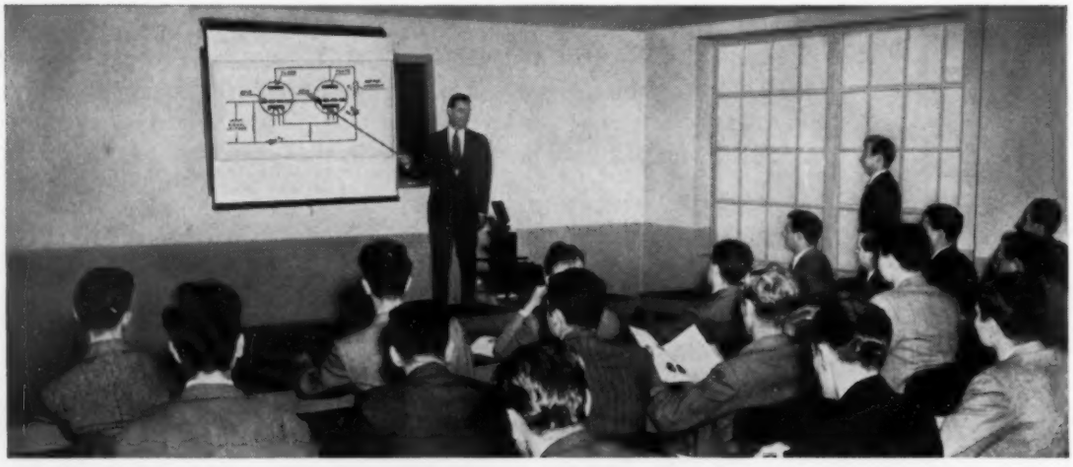
Honeywell service men are schooled not only in the theory of measurement and control, but also in the practical art of keeping good instruments in the best condition. Hand picked men begin this instrument education in an intensive training program in Honeywell factories. After graduation, they serve an apprenticeship in the field offices . . . while they learn still more about instrument maintenance from first-hand contact with plant problems. By the time a Honeywell man arrives at your plant on a call, he's a finished product worthy of the responsibility he bears, and capable of doing the kind of service job that you need . . . and that your Honeywell instruments deserve.

When trouble strikes, a wire or telephone call will bring a service man to your plant . . . often within a few hours. This assurance of prompt action means a lot to your production schedules. You'll never be left out on a limb because of delays in instrument maintenance.

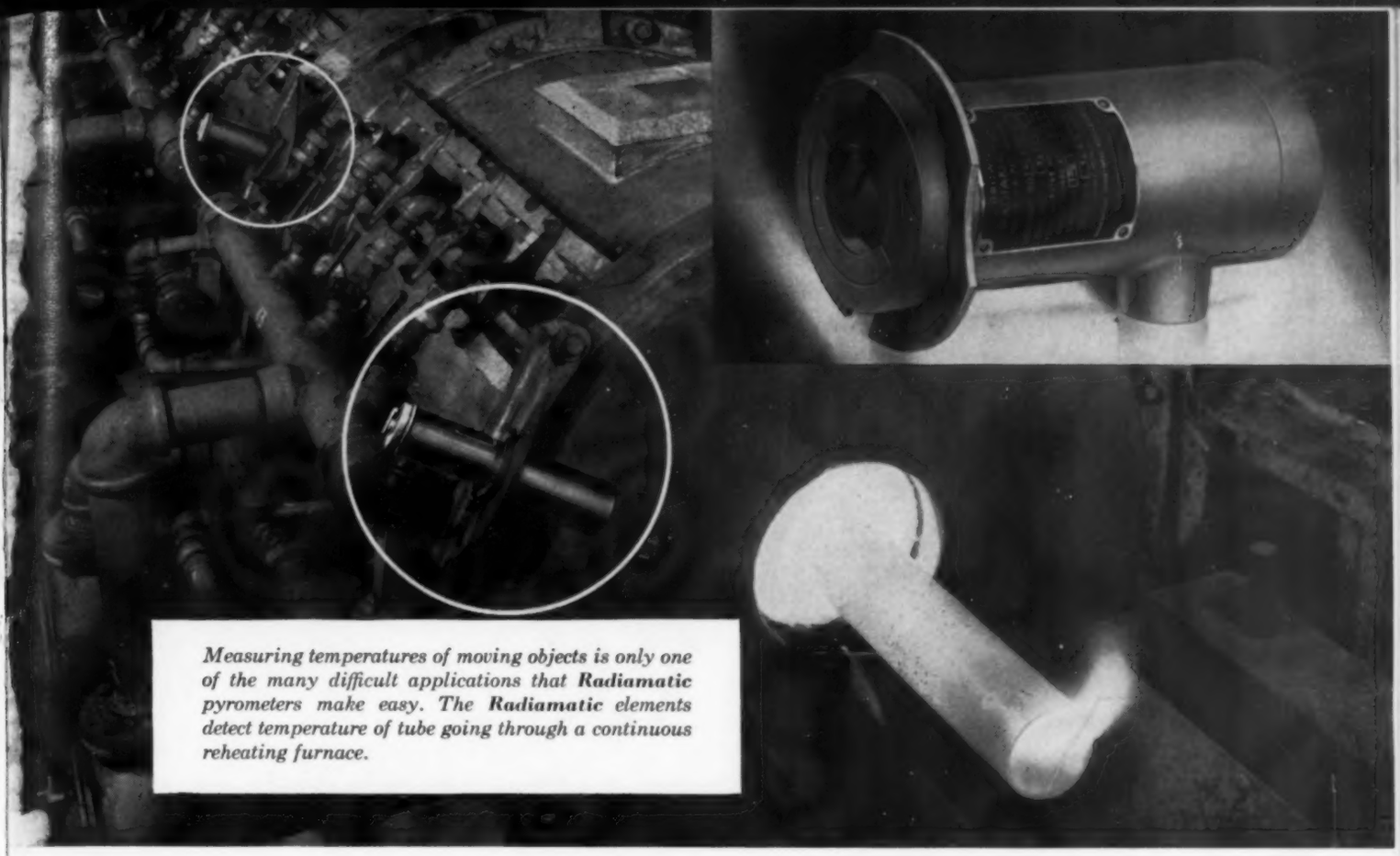
Periodic Service Plan

But why wait for emergencies? Preventive medicine works on instruments, too. And the prescription is simple . . . a Periodic Service Contract, which brings a Honeywell service man to your plant at regular intervals to inspect, clean and adjust any Honeywell instruments you have. The plan is economical . . . can save you many hours of lost production time. Your nearest Honeywell office will be glad to give you full details.

Get those *with*



TRAINED TO SERVE: *In Honeywell's service school, students get a thorough grounding in instrument theory and practice. After graduation, they become part of the most extensive organization of its kind in the world . . . ready to serve you competently and promptly, whenever and wherever you need them.*



Measuring temperatures of moving objects is only one of the many difficult applications that ***Radiamatic*** *pyrometers make easy. The* ***Radiamatic*** *elements detect temperature of tube going through a continuous reheating furnace.*

"tough spot" temperatures *Radiamatic pyrometers*

CALL on *Radiamatic* pyrometers whenever temperatures are too high . . . atmospheres too destructive . . . or vibration too severe for thermocouples. Call on them, too, for jobs that other types of pyrometers simply can't do—such as measuring temperatures of moving objects, and surface temperatures of work in furnaces.

To assure you of accurate measurement and ready adaptability, *Radiamatic* pyrometers offer these features:

READY INTERCHANGEABILITY:
all *Radiamatic* pyrometers are calibrated to a fixed standard . . . are as interchangeable as thermocouples.

EASY SIGHTING:
aiming the Radiamatic at the desired target is as easy as looking through a telescope.

SAFETY SHUTTER:
protects the element against backfiring flames.

VERSATILE INSTALLATION:
accessories include air-cooled and water-cooled fittings, and open and closed end sighting tubes of varied types.

TEMPERATURE COMPENSATED:
no cooling devices needed for high ambient temperatures.

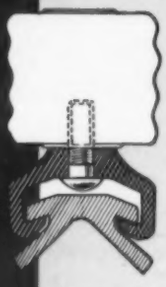
Radiamatic elements and companion *ElectroniK* instruments are supplied in ranges from 125 to 7000° F. Your local Honeywell engineer will be glad to discuss your own applications . . . and he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Aves., Philadelphia 44, Pa.

● **REFERENCE DATA: Write for Catalog 9301, "Radiamatic Pyrometers."**

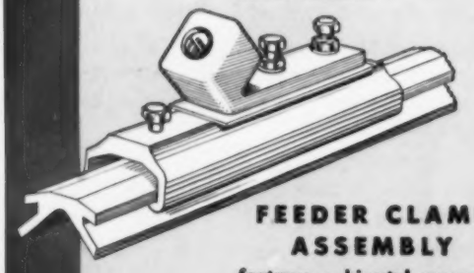
MINNEAPOLIS **Honeywell**
BROWN INSTRUMENTS
First in Controls

The Keystone INTEGRATED ALUMINUM* Conductor System



HANGER SECTION
Conductor free to slide within support, allowing for expansion and contraction.

JOINT PLATE AND BOND ASSEMBLY
Non-loosening spring-type splice plate provides excellent electrical and mechanical joint characteristics between conductor sections.



FEEDER CLAMP ASSEMBLY
features a bimetal separator that eliminates galvanic corrosion between copper terminal and aluminum surface, providing foolproof, long-lasting connection.

LOWER COST

LIGHTER WEIGHT, HIGHER EFFICIENCY

SAFER ENCLOSURES

An integrated power supply system designed to complement the best materials handling equipment—1000 amperes capacity for heavy duty systems . . . economical for use on control circuits.

The Keystone Aluminum Conductor System is now being employed in outstanding installations, after having been developed through years of research in the laboratory and industry. It has been carefully designed to solve the troublesome problems formerly encountered.

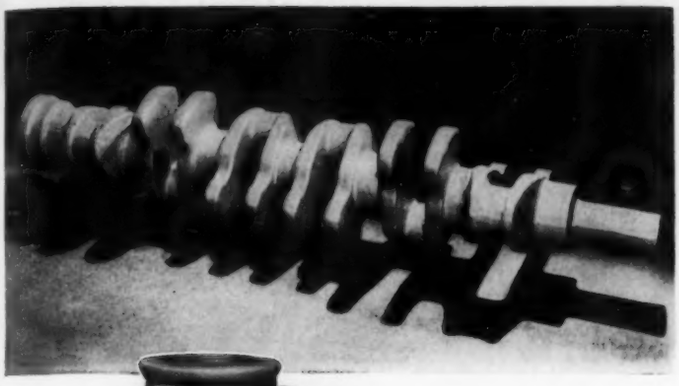
The light weight of this conductor system reduces costs of installation, insulators and supporting structures. Its non-corrosive qualities permit use on sensitive control circuits. Longer contact life. Compact design saves space, permits better protection. All components are pre-fabricated. Available complete with brackets and enclosures. No copper boosters nor priorities needed. Easily engineered, installed and maintained.

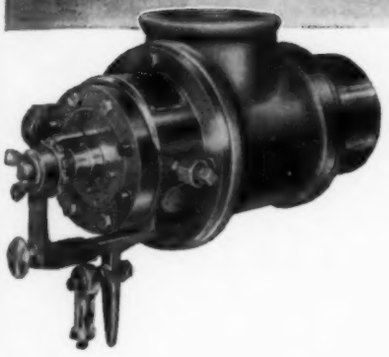
*Domestic and Foreign Patents Pending

Write today for new, illustrated 4-page folder on Keystone Integrated Aluminum Conductor System.

ELECTRIC SERVICE MANUFACTURING CO.

PHILADELPHIA 32, PENNA.





from the Smallest to the Largest Crankshaft Forgings

From the smallest to the largest crankshafts are forged for the automotive, diesel-truck engine and farm implement industries by Wyman-Gordon Co. They are heated in large, modern furnaces of the pusher, box and rotary hearth type, fired by

HAUCK PROPORTIONING OIL BURNERS . . .

The reason so many of their furnaces are Hauck-equipped is because experience has proved Hauck Proportioning Oil Burners—

1—Maintain constant CO_2—by automatic fuel-air self-proportioning, so important in minimizing scaling of work.

2—Plant men do not have to touch burners while changing dies or when changing shifts.

3—They can maintain production with low service costs on the burners.

This record of Hauck burner performance, duplicated in other forge shops, merits your investigation. Write for Catalog 410.

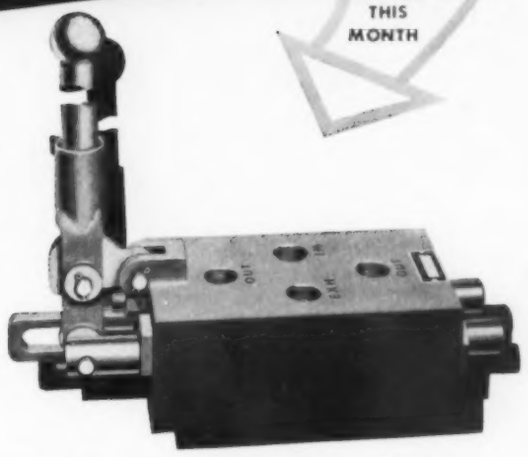
HAUCK MANUFACTURING CO.

Combustion Engineers • Manufacturers of Oil and Gas Burners and Equipment

114-124 Tenth Street • Brooklyn 15, N. Y.

Quick-As-Wink AIR AND HYDRAULIC Control Valves

FEATURE THIS MONTH

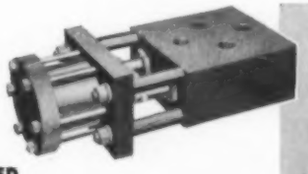


Lever Operated Hydraulic Valves

For line pressures up to 5000 psi

● Unsurpassed for efficient trouble-free service controlling single or double acting hydraulic cylinders and other important high pressure hydraulic circuits. Positive, fast acting. All parts are in pressure balance, eliminating any tendency to creep or crawl. Machined steel housings, with chrome plated and polished stainless steel plungers. Self sealing U-packers. Metal valving rings take the impingement of the liquid, minimizing wear on the packings. ½" to 1½" sizes. Also available in pilot operated designs; sizes to 4". Write for details.

also the following



PILOT CYLINDER OPERATED HYDRAULIC VALVES

Two position valves 1½" to 4" sizes for line pressures from 1000 to 5000 psi. Valve is placed close to the work and operated from a central control point with an easy to handle air valve avoiding operator fatigue.

SOLENOID OPERATED AIR VALVES

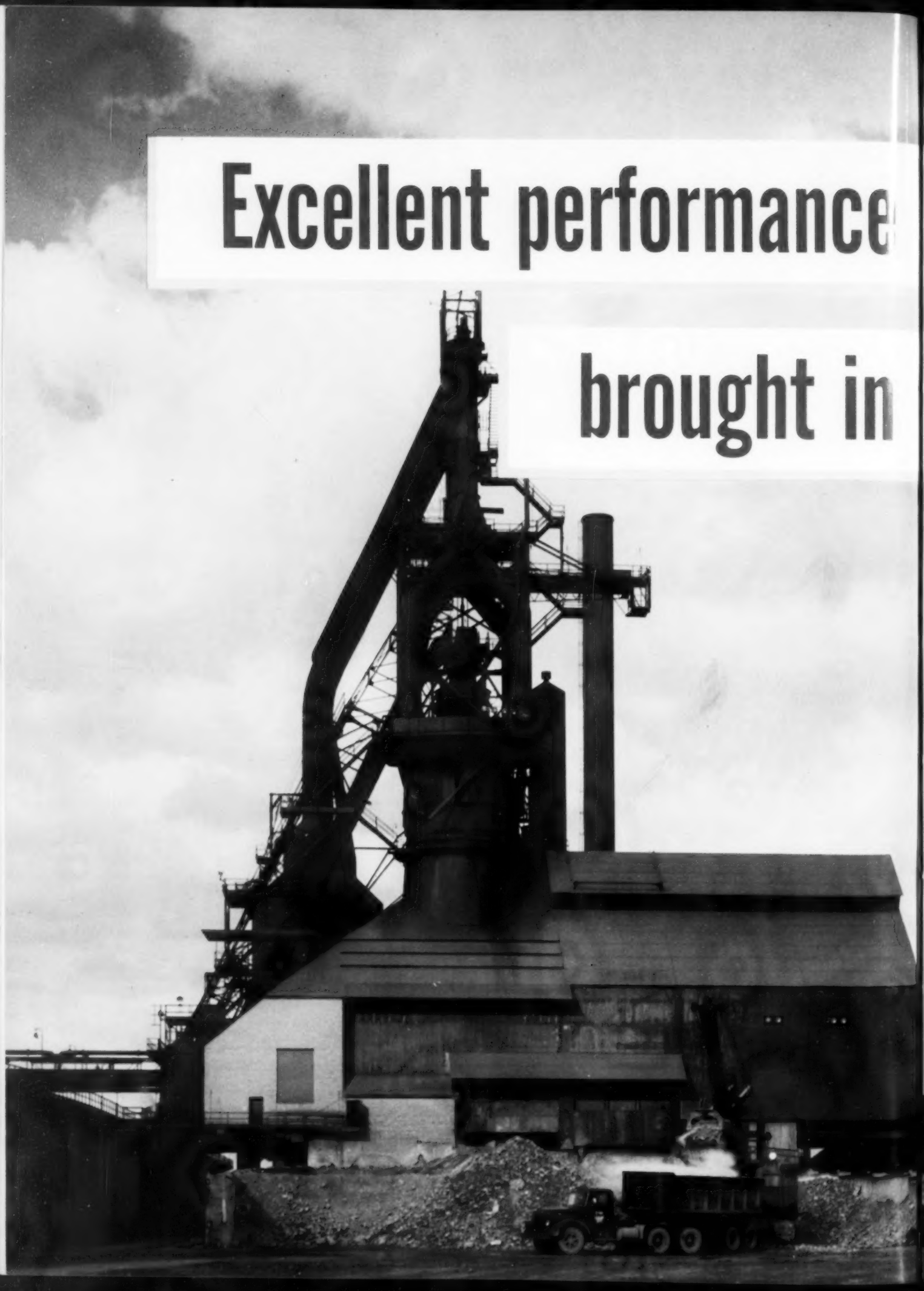
Widely used for controlling single and double acting air cylinders, clutch and brake controls, etc. Solenoid is directly connected to valve operating mechanisms. ⅜" to 1½" sizes. 2-way, 3-way and 4-way actions.

For Fully Descriptive Data Sheets Write

C. B. HUNT & SON, Inc.

Hand, Foot, Lever, Cam, Pilot, Diaphragm and Solenoid Control Valves

1923 EAST PERSHING STREET • SALEM, OHIO


Excellent performance
brought in

# of this new blast furnace

a repeat order!

FREYN Department of Koppers Company designed and erected Blast Furnace "D" for Great Lakes Steel Corporation of Detroit. It was blown in on September 22, 1952. Its hearth diameter is 28 feet.

Rated at 1,400 net tons of pig iron daily, this Freyn-Design Blast Furnace, from January 1 through May, had an average daily production of 1,501 tons—107 per cent of rating. The ore charge was, if anything, below average quality and no sinter was used. Nor was the furnace heavily "scrapped"—less than 6 per cent of the output came from scrap charged.

Such performance can be attributed, in large measure, to a combination of fine equipment, skillfully devised lines developing unusually large relative working volume, plus a highly competent scheme of charging which was selected by the operator.

Great Lakes Steel has just ordered a new Freyn-Design Blast Furnace—a duplicate of "D" whose excellent performance led to the placing of this repeat order.

Constructing blast furnaces is just one way in which Koppers serves the steel industry. For any kind of metallurgical construction, you can count on Koppers. You are invited to consult with our Engineers and Management.

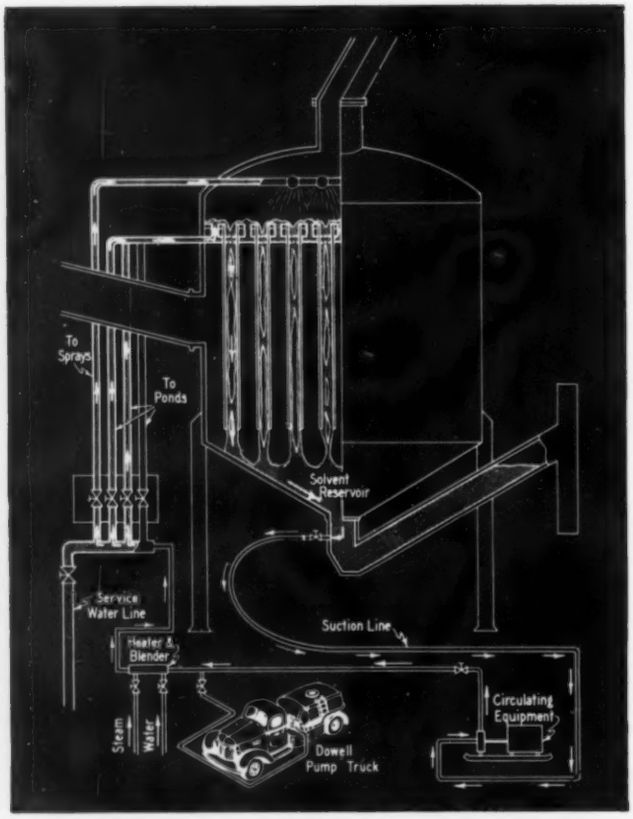
KOPPERS®

Engineering and Construction Division

KOPPERS COMPANY, INC., PITTSBURGH 19, PENNSYLVANIA

Electrostatic Precipitators Cleaned in Just 12 Hours

Dowell Service Saved 178 Hours of Downtime by Cleaning with Chemicals



A diagramatic sketch showing hook-up for cleaning precipitators. Dowell Service engineers bring all necessary chemicals, pumps and other equipment right to the job.

Saving downtime is more important than ever. That's why Dowell Service is specified for maintenance cleaning by an ever-increasing number of companies.

One steel company had a series of precipitators with the usual collection of caked dust and corrosion products. To clean by reaming and scraping would have taken an estimated 190 hours. Dowell Service removed the deposits by flooding weirs and ponds with specially prepared solvents. *The job was completed in just 12 hours!*

An unusual case? Not at all! A check list of steel mill equipment reveals 50 different pieces of equipment that have been cleaned chemically by Dowell Service.

Free Bulletin on Chemical Cleaning for Steel Mill Equipment

Send today for this informative bulletin on steel mill maintenance cleaning. Contains descriptive case histories plus handy check list of equipment cleaned by Dowell. Write to Dept. K-29 Tulsa, Oklahoma.

DOWELL SERVICE

Acidizing • Perfojet • Electric Pilot • Paraffin Solvents • Fracturing • Corban® • Jelflake® • Bulk Inhibited Acid • Chemical Cleaning for Heat Exchange Equipment

DOWELL INCORPORATED • TULSA 1, OKLAHOMA

A Subsidiary of The Dow Chemical Company

"First in Oilfield Acidizing . . . Since 1932"

DOWELL

A Service Subsidiary of

THE DOW CHEMICAL COMPANY

Date-line Diary...

October 2

▲ Jones & Laughlin Steel Corp. and National Steel Corp., two leading steel producers are absorbing transportation costs to meet competitors' prices. Other steel companies are studying the situation.

▲ Pittsburgh Consolidation Coal Co. purchased National Steel Corp.'s Weirton Mine for $1,500,000. The mine will not be used as equipment will be transferred to other plants.

October 5

▲ The Defense Mobilization Committee plans a protective construction program whereby large producers may reduce damage of enemy bombing by 1/3 by sturdier buildings costing about 20 per cent above normal. Companies adopting such construction will be granted rapid tax write-offs.

▲ According to the Commerce Dept., manufacturers sold $25,300,000,000 worth of products in August, about $2,700,000,000 above August 1952.

▲ American earnings were at a record annual rate of $284,000,000,000 in the first 8 months of 1953, or $20,000,000,000 above the same period in 1952, according to the Commerce Dept.

▲ The Colorado Fuel & Iron Corp. opened a new $30,000,000 seamless tube plant at Pueblo, Colo. This will supply tubing and casing to oil and gas industries in western U. S. and Canada. It is the first plant of its kind west of the Mississippi.

▲ The AISI reports that operating rate of the steel industry for the week beginning October 5 is scheduled at 94.6 per cent of capacity. This is equivalent to 2,132,000 tons compared with 2,149,000 tons one week ago.

October 6

▲ Nickel supplies were opened to unrestricted civilian use effective November 1. Nickel allocations will continue for some stockpile requirements.

October 7

▲ At $25,900,000,000, public and private construction contracts were the highest in history for the first nine months of 1953, up 7 per cent for this period in 1952. Private spending for this period totaled $17,500,000,000, up 9 per cent above 1952.

October 8

▲ Great Lakes Steel Corp. idled 600 employees for two to three weeks due to current adjustment in inventory and model changes by customers.

▲ Inventories for wholesale and retail firms in August totaled $77,800,000,000 which is $6,000,000,000 above one year ago.

October 9

▲ The Agriculture Dept. estimated the 1953 cotton crop at 15,600,000 bales, 460,000 bales above last year's output.

▲ U. S. Steel Corp. said it was nearing completion of its $2,200,000,000 expansion and modernization program underway since 1941 and of this Fairless and Cerro Bolivar are to be completed.

October 10

▲ Deliveries of new domestic freight cars in September totaled 5706 compared with 5557 in August, and 3762 in September 1952, as announced by the ARCI and AAR. Backlog on October 1 was 42,198.

October 12

▲ The Agriculture Dept. cut their 1953 corn crop estimate to 3,200,000,000 bushels.

▲ The Office of Defense Mobilization issued to Great Lakes Steel Corp. in Ecorse, Mich. a $10,800,000 certificate of necessity for rapid tax amortization for steel sheet, plate and strip facilities.

October 13

▲ The AISI reports that operating rate of the steel industry for the week starting October 12 is scheduled at 94.4 per cent of capacity. This is equivalent to 2,129,000 tons compared with 2,146,000 tons one week ago.

▲ As reported by the Aluminum Association, primary production of aluminum totaled 221,090,007 lb in August and 218,570,626 lb in July, compared with a total of 170,350,658 lb in August 1952.

▲ Republic Steel Corp. reports operations for the third quarter rose to $292,000,000, one-third more than the same period in 1952. Net profits in the September quarter rose to $2.30 per common share, $1.49 above one year ago.

October 14

▲ AISI reported total employment in August continued high and average hourly wages were $2.318, or 0.8¢ higher than in July. Total employment in August was 695,600, working an average 38.2 hours per week. Total payroll was $287,253,000.

October 15

▲ Granite City Steel Co. recently reduced price on carbon steel plates by $6 per ton, hot-rolled carbon sheets (18 gage and heavier) were reduced $2.50 per ton, and cold-rolled carbon steel sheets were reduced $5.40 per ton.

▲ Britain cut export prices on steel plate 15 per cent due to weakness of the international market and recent agreement by producers in France, Germany, Belgium and Luxembourg to lower export price $10 per ton.

▲ Directors of The Youngstown Sheet and Tube Co. declared a dividend of $0.75 a common share. Total income was $143,618,135 for the third quarter, net income was $8,057,691 or $2.41 a share compared with $0.76 a share in the third quarter of 1952.

October 16

▲ U. S. Steel Corp. announced operation of bar mill facilities will begin at Fairless Works in November. Standard bars and small shapes and concrete reinforcing bars will be made in a limited volume.

October 17

▲ The F. W. Dodge Corp. announced construction contract awards for September in the 37 states east of the Rockies has increased 23 per cent since August to $1,741,673,000.

October 19

▲ Iron and steel scrap export restrictions were lifted by the Commerce Dept. for the remaining three months of 1953.

▲ Sales for Allegheny Ludlum Steel Corp. amounted

to $58,226,523 for the third quarter of 1953. Net earnings for this period were $2,038,776, or $1.18 per share compared with $0.56 for the same quarter last year.

▲ The AISI reports that operating rate of the steel industry for the week starting October 19 is scheduled at 94.8 per cent of capacity. This is equivalent to 2,137,000 tons compared with 2,172,000 tons one week ago.

October 20

▲ General Electric Co. sales were at a volume of $780,000,000 for the third quarter, $2,000,000 under the June quarter.

▲ Lukens Steel Co. declared a quarterly dividend of 25¢ and an extra dividend of 50¢ per share from its net earnings.

October 21

▲ Refined copper price increased ½¢ to 29½¢ a lb by leading custom smelters.

▲ The AISI reported last week's steel production of 2,172,000 tons was 22 per cent above the average weekly production of 1952. Production for 1953 was estimated at 112-113,000,000 tons.

October 22

▲ The Traffic Executive Association filed with ICC reduced railroad freight rates on iron and steel products in the eastern to southern territory, effective November 21.

▲ Factory employment dropped 60,000 in the month to mid-September, a contrast to the usual increase of 200,000 employees.

▲ Allotments of steel, copper and aluminum to defense users were cut sharply by the government because of drop in arms production.

October 23

▲ President of the Granite City Steel Co., John N. Marshall, reported that 1953 earnings will be the best in the history of that company. Third quarter profits were $2,119,000 or $1.41 per share compared with $0.68 last year.

▲ Sharon Steel Corp. announced to shareholders a net income for the third quarter of $1,681,034 or $1.53 per share of common stock compared with $1.27 last year.

▲ Westinghouse Electric Corp. will build the first full scale atomic power plant in the U. S. producing at least 60,000 kw of electrical energy.

▲ CIO steelworkers will add the annual guaranteed wage to its demands next spring.

▲ Machine tool makers orders in September declined to $64,000,000 from $84,500,000 in August and $89,000,000 in September 1952.

October 26

▲ C. M. White, president of Republic Steel Corp. says its Massillon, Ohio plant will increase rolling capacity of finished stainless steel by 1800 tons a month. Expansion is planned for completion by mid 1955.

▲ Pittsburgh Steel Co. placed 6 new soaking pit furnaces into operation at Monessen, Pa.

▲ Inland Steel Co. reported a record production, shipment and sales for the first nine months. Net income for this period was $24,049,317 or $4.91 a share, up 49 per cent from $16,139,754 or $3.29 a share in the like period for 1952. Third quarter sales were $149,778,503, net income was $8,371,796 or $1.71 a share.

▲ Unemployment rose slightly, in the past few weeks due chiefly to cutbacks in automotive, industrial machinery, transportation equipment and textile industries.

▲ Jones and Laughlin Steel Corp. reported its net income for the third quarter of $8,807,000 or $1.36 a share of common stock, and compared with a net income of $810,000 or $0.08 a share for the like period in 1952. Sales for the third quarter totaled $160,504,000.

▲ Armco Steel Corp. earned in the third quarter $10,042,784 net, or $1.93 per share of common stock compared with $1.49 in 1952. The first 9 months net earnings were $26,121,317 or $5.01 per share in comparison with net earnings of $22,305,678 or $4.28 per share for the like period of 1952. Sales for the first three quarters were $445,072,438.

▲ The AISI reports that operating rate of the steel industry for the week beginning October 26 is scheduled at 93.7 per cent of capacity. This is equivalent to 2,112,000 tons compared with 2,142,000 tons one week ago, and 2,229,000 tons one year ago.

▲ Acme Steel Co. announced a quarterly dividend of $0.40 per share, total sales for the third quarter of $18,135,247 as compared with $20,037,192 for the previous quarter. Net earnings per share were $0.56.

▲ Steel scrap prices increased $4 a ton in the Chicago area.

▲ The AISC reported September shipments of fabricated structural steel amounted to 255,599 tons. Bookings during September were 217,600 tons, down 11 per cent from August. Backlog of work ahead as of September 30 stands at 2,040,534 tons.

October 27

▲ Earnings of U. S. Steel Corp. for the third quarter allowed a dividend of $1.75 per share on common stock with total net income for this period of $61,706,-264, or $2.12 a share. Income for the first nine months is reported at $166,723,023.

October 28

▲ Jones and Laughlin Steel Corp. will cut output by 9 per cent around November 1 and will lay off 300 to 350 employees. Five open hearth furnaces and one blast furnace will be shut down at the Pittsburgh works.

October 29

▲ National Steel Corp. reports net earnings for the quarter ending September 30 of $13,003,384 or $1.77 per share in comparison with earnings of $7,234,419 or $0.98 per share for the like period in 1952.

▲ Crucible Steel Co. of America announced net earnings for September 30 quarter at $1,637,566, or $1.88 per share on common stock, compared with $1.31 for the third quarter in 1952.

▲ The RFC is planning to get the Government out of the $50,000,000 synthetic gas plant of Carthage Hydrocol, Inc. at Brownsville, Texas.

▲ Rem-Cru Titanium, Inc. hopes to increase titanium output at its Midland, Pa. plant 300 per cent during the first 6 months of 1954, going from 3 to 10 tons per day.

October 30

▲ Steel scrap, No. 2 heavy smelting, and No. 2 bundles recovered their recent price drop, increasing in Pittsburgh $3 a ton.

▲ Bethlehem Steel Co. reported net earnings for the September 30 quarter at $34,030,204 or $3.38 per common share, compared with $1.62 a share the previous year. Total billings for the quarter were $513,574,386.

designed to save manpower and reduce upkeep costs

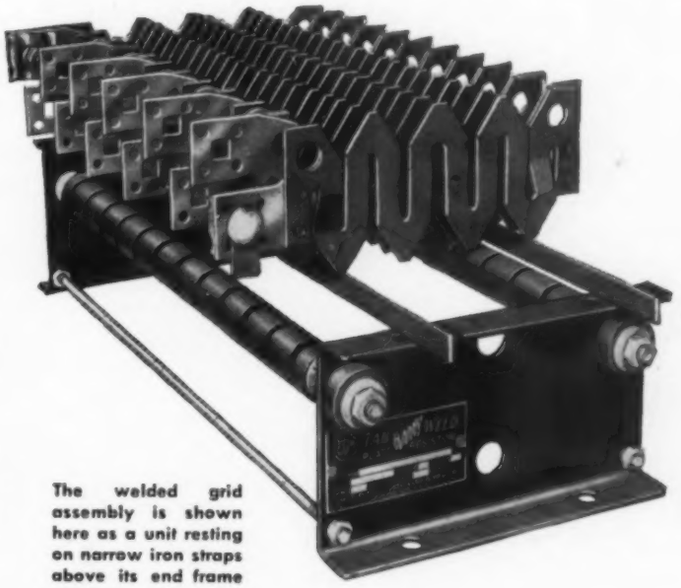
The welded GRID-ASSEMBLY steps up resistor-performance these 3 ways:

1- STABILIZES the ohmic value, independent of the clamping-nuts.

2-STOPS BURNING at grid-eyes and at tap-plates.

3-SIMPLIFIES tap-shifting, when adjusting resistance for best motor operation—also makes it easier to replace sections.

For reduced maintenance where maintenance can be easily overlooked, switch to EC&M Tab-Weld PLATE RESISTORS.



The welded grid assembly is shown here as a unit resting on narrow iron straps above its end frame support rods, and spacers.

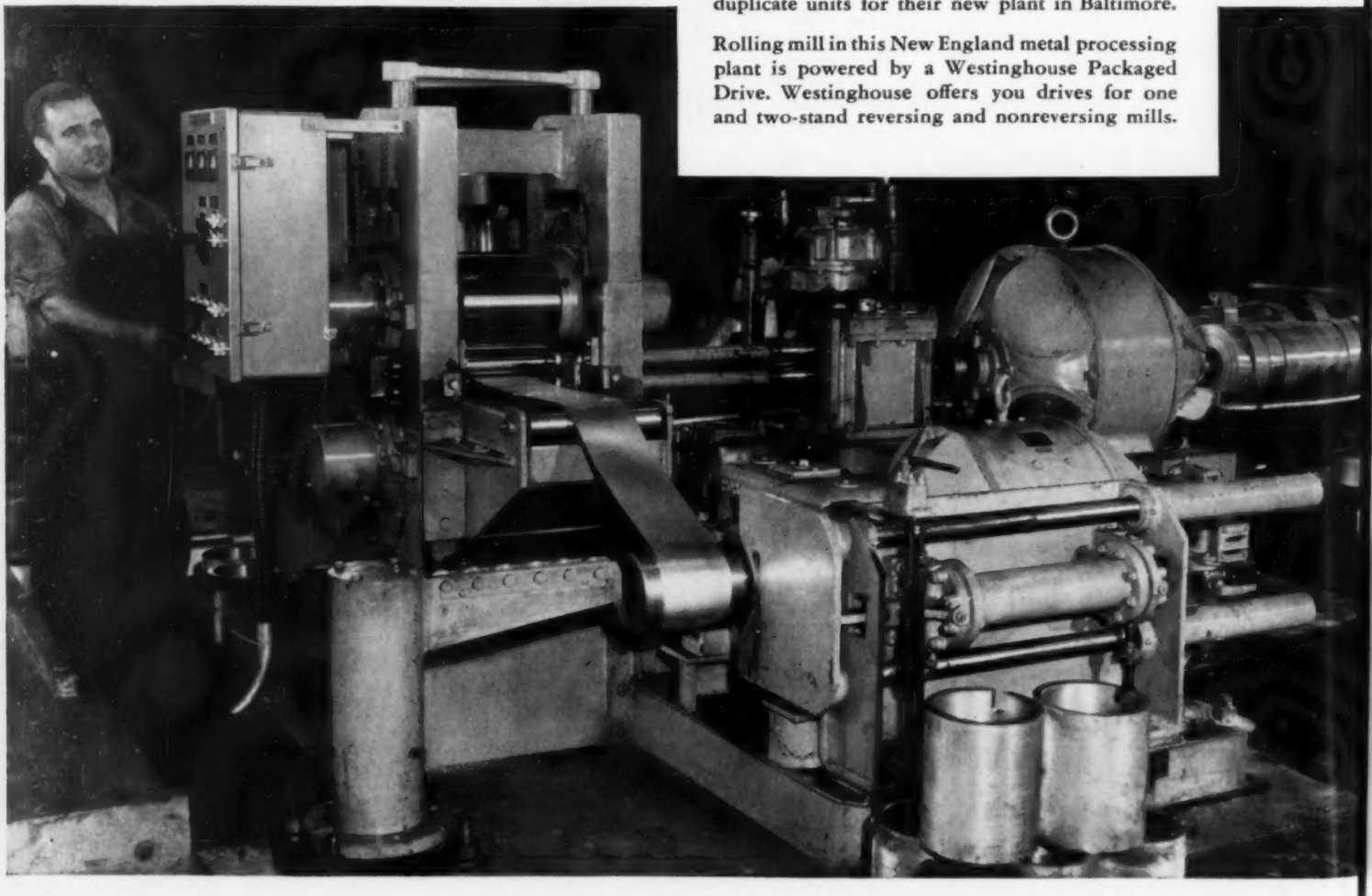
SPECIFY BULLETIN 942 EC&M TAB-WELD RESISTORS

E&M

THE ELECTRIC CONTROLLER & MFG. CO.

2698 EAST 79TH STREET ★ CLEVELAND 4, OHIO

Another customer, Thompson Wire Company, Franklin Park, Illinois, uses four Westinghouse Bell Furnaces on 12 bases. New operation gives Thompson greater load per heat and lower maintenance costs. Success persuaded Thompson to order duplicate units for their new plant in Baltimore.



Rolling mill in this New England metal processing plant is powered by a Westinghouse Packaged Drive. Westinghouse offers you drives for one and two-stand reversing and nonreversing mills.

Westinghouse furnaces and drives help you reheat and roll your own

Many fabricators of steel, brass and aluminum products are learning that processing metals to their own specifications is practical and profitable. Ahead of the trend, Westinghouse engineers have developed both electric and gas-fired, bell-type furnaces for reheating and packaged drives to run small rolling mills. Here's a report from one customer . . .

Three-base hit

A Westinghouse Bell Furnace bright-anneals low carbon steel, for Venetian blinds at Rodney Metals, Inc., New Bedford, Mass. The three-base installation operates nonstop. While one batch of steel (two coils, each 24½ inches wide and weighing two tons) anneals under the bell, another batch cools under the hood on base No. 2, and another is loaded or unloaded on base No. 3. "Maintenance," says Frank L. Morse, Rodney's chief engineer, "is practically nil."

Steady heat

"We use sheet steel in gauges from .002 to .060, annealed and scale-free to save cleaning before our plating and painting steps," says Mr. Morse. "That means constant atmosphere and temperature control. Westinghouse Exogas® generating and regulating equipment, installed with our new bell furnace, fills the bill 100%."

Working for yourself

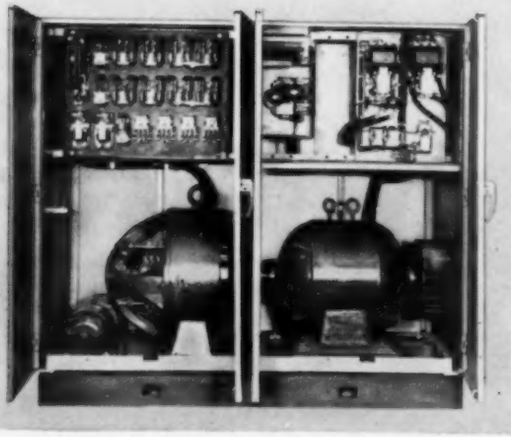
Mr. Morse sums up the advantages of doing your own annealing and rolling. "We get a better price on steel coils, based on volume. We carry a smaller, concentrated inventory. We reduce and anneal to *our* specifications—without waiting for outside suppliers. We avoid down time because, with a Westinghouse integrated operation, our own warehouse can supply any gauge or hardness to our production line!"

Let Westinghouse help

Westinghouse engineers can plan and install a packaged drive and heat-treating furnace in your plant. For more information, simply phone your nearby Westinghouse representative. Westinghouse Electric Corporation, Pittsburgh 30, Pa. J-94001

YOU CAN BE SURE...IF IT'S

Westinghouse

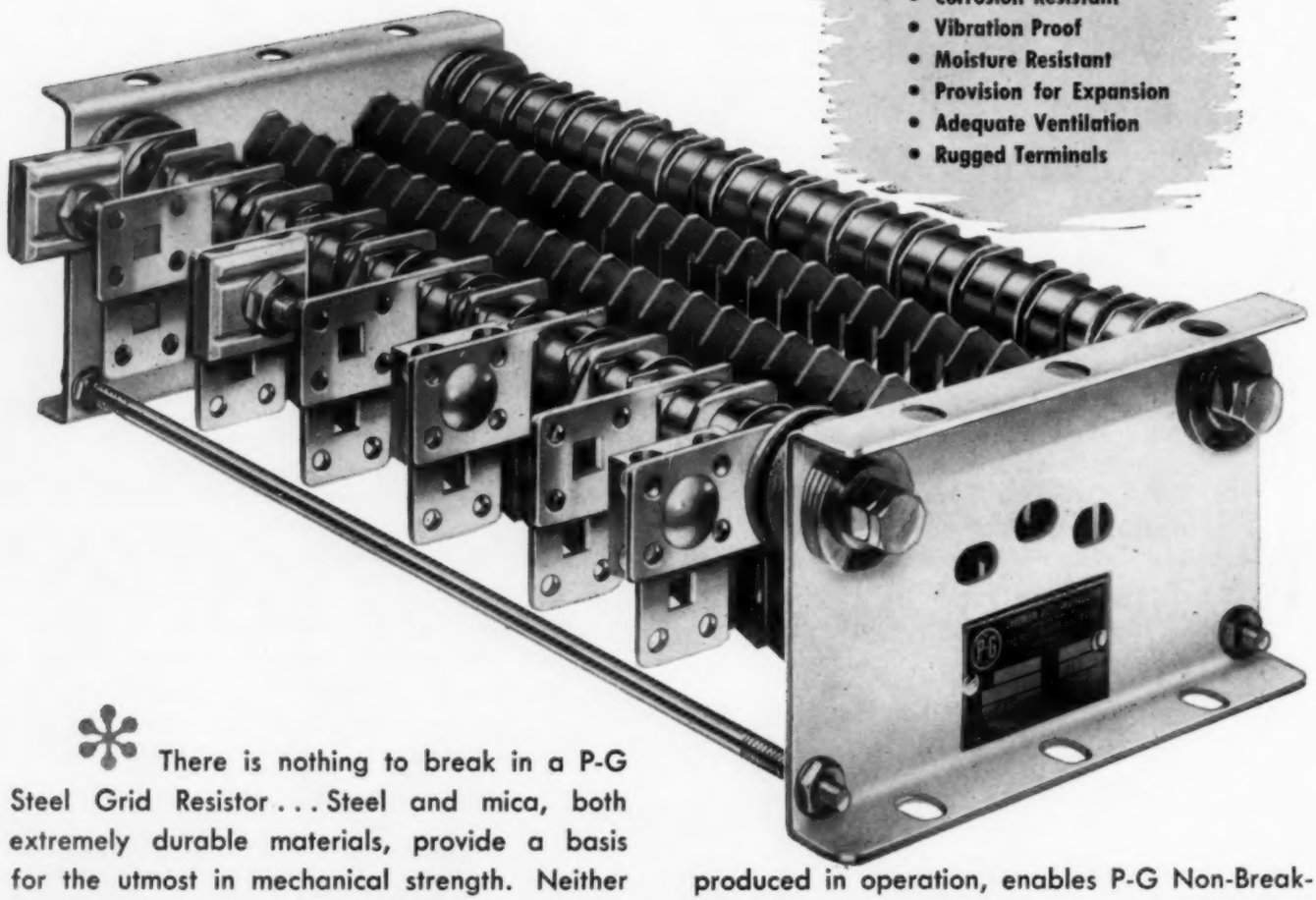


Packaged drives, in neat, compact cabinets, are easy to install and operate. At left: exciter and d-c generator. At right: a-c motor.

BUILT OF *Steel* AND *Mica*

NOTHING TO BREAK . . .

- Steel Construction
- Mica Insulation
- Corrosion Resistant
- Vibration Proof
- Moisture Resistant
- Provision for Expansion
- Adequate Ventilation
- Rugged Terminals



There is nothing to break in a P-G Steel Grid Resistor . . . Steel and mica, both extremely durable materials, provide a basis for the utmost in mechanical strength. Neither do vibration, nor moisture laden or corrosive atmospheres have material effect on P-G Resistors . . . This, together with provision for expansion as well as efficiency in dissipating heat produced in operation, enables P-G Non-Breakable Resistors to give long and trouble-free service . . . The next time that troublesome application is at hand, specify P-G and solve your maintenance problem.

Write for Bulletin No. 500

P-G

The Nonbreakable Steel Grid Resistor

THE POST-GLOVER ELECTRIC COMPANY

• ESTABLISHED 1892 •

221 WEST THIRD STREET, CINCINNATI 2, OHIO

Industry News...

PITTSBURGH STEEL PUSHES CONSTRUCTION ON COLD ROLLED SHEET MILL AT ALLENPORT

▲Construction of Pittsburgh Steel Co.'s $12-million cold rolled sheet mill is pushing ahead rapidly at Allenport, Pa.

Recently 1,300 cu yd of concrete were poured in a continuous pouring operation that began at 7 a.m. and took about 13 hours. That's enough concrete for the foundations of about 130 average-sized homes.

A total of 27 mixing trucks were used to carry the concrete to the foundations of the four-stand tandem mill and motor room.

It was the largest single pour of concrete made in the Monongahela Valley area during recent years for industrial construction.

The cold rolled sheet mill, under construction adjacent to Pittsburgh Steel's new $28-million hot rolled sheet mill at Allenport, will require a total of about 22,000 cu yd of concrete in its foundations.

Following completion of the foundation work, installation of rolling mill equipment, annealing furnaces, and finishing facilities will begin. First production from the mill is expected early next year.

Start of operations at the cold rolling mill will mark completion of Pittsburgh Steel's $62-million expansion program that has increased its steelmaking capacity by 48 per cent, increased its capacity to make finished steel products by 82 per cent, and launched the company into the sheet steel market for the first time.

Pittsburgh Steel also has announced the start of operations at six new soaking pit furnaces for heating steel ingots at the Monessen,Pa., works.

Part of a $3.5-million program to build 15 furnaces, this latest addition raises to 12 the number of new furnaces now in production. The final three furnaces in the program are scheduled to be in operation early next year, and will complete one of the most modern batteries of soaking pits in the industry.

The six new furnaces are arranged in two blocks of three furnaces each. Together with the six furnaces in two blocks already completed, the new installation of four blocks will have a capacity to heat about 2,700 net tons of high quality steel ingots every 24 hours—enough steel to build over 1,200 automobiles.

This will substantially improve the flow of steel shapes to the wire mills at Monessen, the seamless tube mills, and the new hot rolled sheet mill at the Allenport Works.

The soaking pits are located between the newly expanded open hearths and the recently installed blooming-slabbing mill at Monessen. The increase in soaking pit capacity will speed delivery of ingots, uniformly heated to rolling temperature, to the blooming mill. In turn, this will permit more steel to be rolled into blooms, slabs, billets, and bars to feed the finishing mills. It will also assure higher quality and provide greater flexibility in rolling schedules.

Built by Amsler-Morton Corp., the four blocks of pits are about the size of a three-story apartment building —102 ft wide, 176 ft long, and 27 ft high from foundations to the top of the furnaces. The outside shell of the blocks is of steel plate. The interior is lined with silica brick.

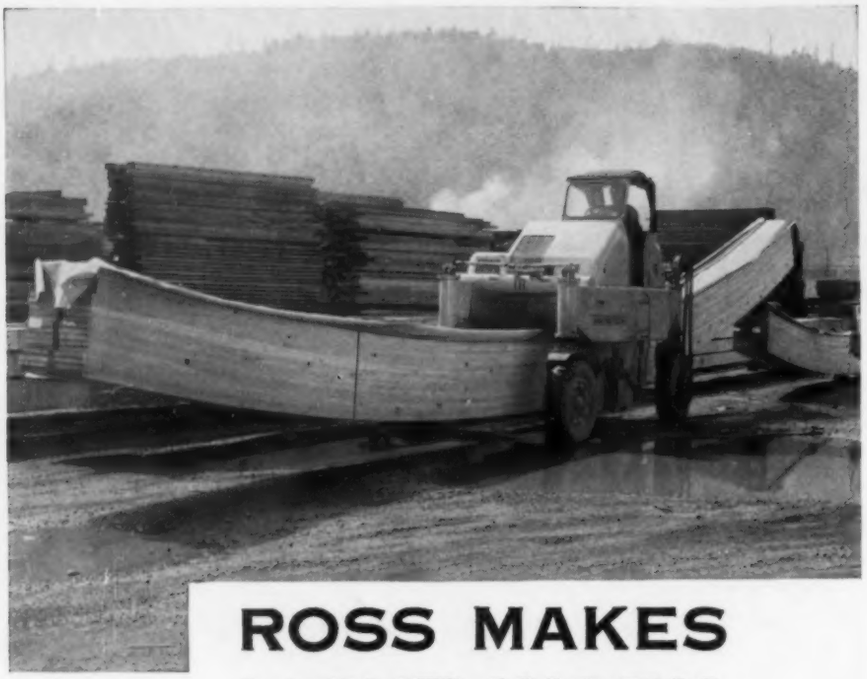
Each furnace in the top of the unit, is 13 ft wide by 16 ft long by 11 ft deep—about the size of a large living room. Steel ingots charged into these furnaces by one of two new 30-ton pit cranes, vary in size from 6 to 16 net tons. One furnace will hold 75 to 100 tons of steel ingots.

Each furnace has a 30 ton cover. Covers are moved on and off the furnaces by a pit cover carriage which spans the entire unit and rides on rails at both ends. Ingots are soaked in the heat of the furnace for an average of five hours, becoming uniformly heated to about 2,400 F. for rolling.

The furnaces are of the center-fired recuperative type, designed for continuous firing to maintain constant temperature. Four types of fuel can be used to fire them: coke oven gas, natural gas, mixed blast furnace

AIR-CONDITIONED CRANE SERVES ELECTRIC FURNACES

A sixty-ton Bedford crane with air-conditioned cab is shown in the new melt shop of Timken Roller Bearing Co., Canton, Ohio. Working directly over the severe flash heat of top charging electric furnaces, it positions and dumps approximately 40 tons of scrap per swing.



ROSS MAKES LIGHT WORK OF JOBS LIKE THIS...

Steel plate, I-beams, pipe, lumber, or long pallet loads —this is the fast, simple way to handle it. Ross Carriers go places that other types of equipment can't go. They move your materials indoors or out, over factory floors, unimproved yards or highways. The speed and mobility of these versatile Carriers enables them to handle materials practically anywhere, under all conditions. With them, you move loads between crane-ways, eliminate unnecessary switching between plant trackage, eliminate costly re-handling. They handle the heaviest loads at the least cost.

ROSS CARRIERS
A complete line to meet your particular needs. Capacities: 10,000 to 45,000 pounds.

For 40 years, world's *first* and *foremost* carriers.

The picture above shows a Carrier handling heavy timber arches. In steel mills and fabricating plants as well, Ross Carriers cut the cost of inter-building transfer of in-process material, of indoor or outdoor storage of finished material. It will pay you to look into the advantages of Ross Carriers for your own operations. Write us today—discussion of your handling problems entails no obligation on your part.

RELY ON ROSS

ROSS CARRIER LINE
Industrial Truck Division
CLARK EQUIPMENT COMPANY
BENTON HARBOR 135, MICHIGAN

A 16-ton slabbing ingot is lifted from one of Pittsburgh Steel Co.'s new battery of soaking pits at the Monessen, Pa. works. Six new pits were put into operation recently, bringing to 12 the number of new units now in operation.

and coke oven gas, and oil. Normally, the furnaces will operate on mixed gas. They are equipped with fully automatic controls to assure efficiency in operations, quality in the steel ingots, and complete uniformity from ingot charge to ingot charge.

The new pits mark another stride forward in the company's overall $62.8-million expansion program now nearing completion. Principal advances in the program include: (1) An increase in blast furnace capacity by 12 per cent. (2) An increase in open hearth capacity by 48 per cent. (3) Construction of five new soaking pits and installation of a new 66-in high-lift blooming-slabbing mill. (4) An increase in finishing facilities of 82 per cent.

TO INCREASE ROLLING CAPACITY AT MASSILLON

▲ Plans to install new facilities which will increase rolling capacity of stainless steel by 1800 tons of finished products a month at the Massillon, Ohio, steel plant of Republic Steel Corp. were announced by C. M. White, president.

Preparations will begin immediately to install a cold rolling mill and auxiliary equipment for cold reducing stainless steel coils. It is anticipated the project will be completed in approximately 18 months.

The main facilities to be installed are a wide cold rolling mill for cold reducing stainless steel coils and a 26-in. two-high skin (temper) mill. The cold rolling mill will be capable of rolling stainless steel strip up to 48 in. wide and down to a minimum thickness of $\frac{1}{64}$ in. The skin mill gives a fine surface to the steel and imparts certain desirable physical properties for fabricating.

Process, finishing, maintenance and handling equipment to be installed includes annealing and pickling lanes, inspection benches, overhead cranes, a combination single and multiple strand cut-up line, resquaring shears, roll grinders, a scrap baller, scales and welding, carpentry and material handling equipment.

In addition, abrasive equipment for cleaning strip stainless steel and coil splicing facilities will be installed to obtain operating efficiencies on existing stainless steel rolling mills.

The new facilities will be housed largely in existing buildings at the Massillon, Ohio, steel plant, although minor alterations and some relocation of present equipment will be necessary. Auxiliary buildings will be constructed where necessary.

New washroom and locker accommodations will be provided for employees by relocating and enlarging existing locker room facilities. To protect employees from accidents, safety controls and equipment will be installed.

Stainless steel for supplying the new rolling mill will be made at the Canton steel plant, where Republic has 17 electric furnaces. The electric furnace is the only type of steelmaking furnace in which stainless steel is made for commercial production.

This is the third major expansion in stainless steel rolling Republic has made at Massillon in recent years. Additions in 1939 and 1948 made the Massillon plant one of the largest and most modern producers of stainless steel in the world.

DESIGNS SMALL PARTS HARDENING FURNACE

▲ Small, light weight parts can now be continuously hardened in a radiant tube, gas-powered shaker hearth furnace available from the Westinghouse Electric Corp. The furnace has a maximum operating temperature of 1700 F and is designed for heat treating medium-carbon, high-carbon, and alloy steels without scale or decarburization in an "Endogas" atmosphere.

In operation, work is loaded on the hearth at the front of the furnace and the reciprocal motion of the shaker charger conveys the parts through the heating chamber until they fall off the discharge end of the hearth into the quenching fluid. The parts are

AMERICAN CHEMICAL PAINT COMPANY

AMBLER CHEMICALS ACP PROCESSES PENNA.

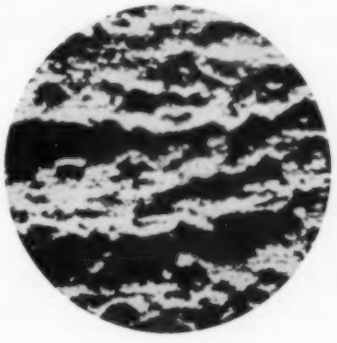
Technical Service Data Sheet

Subject: EFFICIENT PICKLING WITH RODINE®

ADVANTAGES OF "RODINE"

RODINE is used in sulfuric and muriatic acid baths for improved pickling and increased production. It meets Government Specification U.S.N. 51-I-2.

In straight line pickling of wire, rod and tubing, RODINE makes available more metal for drawing by protecting steel from acid attack. In batch pickling of sheet steel, RODINE improves the surface. In rapid, continuous strip pickling, RODINE not only saves acid and metal, but also prevents over-pickling during line shutdowns.



◀ *This steel surface was pickled in an uninhibited acid bath. Note the deep pits, and that the surface is visibly crystalline.*

This surface was pickled exactly like the one above except that "RODINE" was added to the acid solution. Only scale pockets and roll marks are visible; no pitting occurred. ▶

CHEMICALS ACP PROCESSES

WRITE FOR DESCRIPTIVE FOLDER ON "RODINE" AND INFORMATION ON YOUR OWN PICKLING PROBLEM.

CHEMICALS ACP PROCESSES

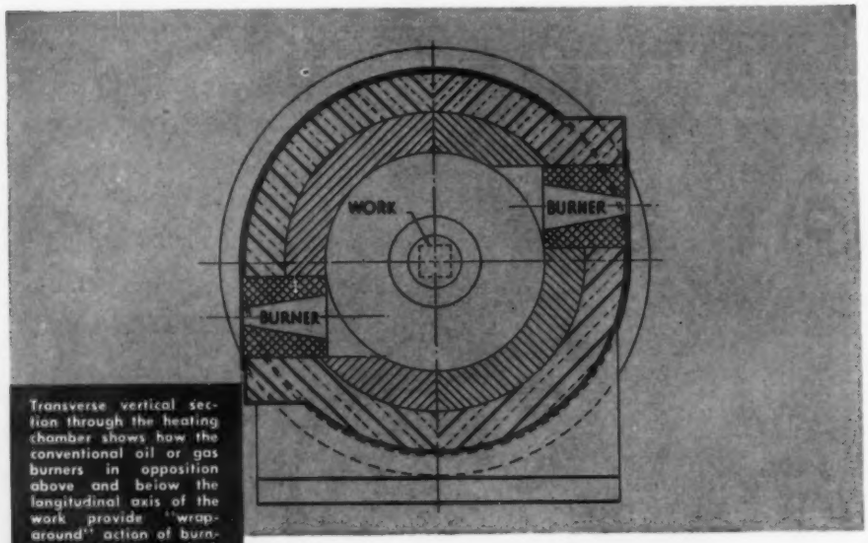
then automatically conveyed from the quench tank on a mesh belt and discharged into tote baskets. The shaker mechanism is mounted on a separate stand so that the furnace receives no shock from the oscillation of the hearth.

The estimated production for this furnace at 1600 F operating temperature, is 400 to 600 lb per hr. The speed of the work through the furnace is adjusted by varying the operating ratio of the speed reducer which, in turn, varies the frequency of oscillation of the hearth.

Charge space of the hardening zone of the furnace is 30 in. wide, 84 in. long, and 3 in. high. Radiant tubes are installed over and under the shaker hearth and are fired from the same side of the furnace.

Typical applications include the hardening of pocket knife blades, small flat springs, screws, bolts and other small hardware. Parts which are round or which will roll en masse are not suitably conveyed by the shaker hearth.

The furnace can also be supplied with electrical heating elements for installations where this type of power is more readily available.



Transverse vertical section through the heating chamber shows how the conventional oil or gas burners in opposition above and below the longitudinal axis of the work provide "wrap-around" action of burning gases at high velocities.

R-S hi-head® heating system

R-S Hi-Head® Heating System prepares bars, slabs, pipe, tubing, and other forms of long, straight stock for forging or heat treatment to meet the most Rigid Standards.

Initial costs are less than with conventional multiple unit methods. Economies are achieved through high speed operation and volume production. Labor costs are reduced as much as 75%.

R-S
QUALITY FURNACES SINCE 1908

R-S FURNACE TYPES

Hi-Head ● Batch ● Rotary Hearth ● Continuous Belt Conveyor ● Continuous Chain ● Continuous Pusher ● Continuous Pusher Tray ● Pit ● Continuous Roller Hearth ● Car Hearth

INLAND CELEBRATES SIXTIETH ANNIVERSARY

▲ Inland Steel quietly observed its 60th anniversary recently when a group of officers and directors visited the original plant of the company in Chicago Heights, Ill.

Inland was incorporated in October, 1893. In the depth of the depression of that year a group of seven young men with $65,000, largely borrowed, bought the equipment of a bankrupt company for $8,800 and launched Inland by installing the second-hand machinery in a $20,000 plant provided them by real estate promoters.

Joseph L. Block, president, speaking recently to a small group of officers and employees of the old plant said, "It seems almost incredible that in this short span of time, less than the life of most men, such an enormous growth has taken place in a corporate enterprise."

He contrasted its original capital of $65,000 with total assets now of $435,000,000. "In its first year of operation, 1894, the company shipped 5,600 tons of steel products," he said. "This year we will ship more than 3,500,000 tons, more than 4 per cent of the total for the nation."

The company's history shows that in an era when steel bars made from re-rolled railroad rails sold for one cent a pound, the plant prospered, after a slow start, and was on a profitable footing by the early 1900's.

With earnings from the Chicago Heights plant and additional financing, the founders of Inland began its present giant steel works at Indiana Harbor, Ind., in 1901. From an original location of 50 acres of sandy lakefront wasteland, the Harbor Works has grown in size to a present area of a thousand acres. It is now the fifth largest steel plant in the United States.

With a capacity to produce 4,500,000 tons of ingot steel a year, the company founded in 1893 ranks eighth in the steel industry. It now owns its own reserves of coal, iron ore, and limestone, and operates its own fleet of boats on the Great Lakes to transport raw materials.

Besides its steel plants, the company has the merchandising organization, Joseph T. Ryerson & Son, Inc., largest steel warehousing company in the United States, and fabricating

subsidiaries which manufacture such steel products as drums, barrels, pails, lath, roofing, and many building and consumer products.

The parent plant of the company has also grown in 60 years to have a capacity to turn out 16 times the tonnage of its first year of operation.

TO OPEN WAREHOUSE IN LOUISVILLE, KY.

▲ A new steel warehouse will be opened by Jones & Laughlin Steel Corp. in Louisville, Ky., this month. This is the second new warehouse to be established by J&L in recent months. The other was opened in Nashville, Tenn., in July.

The Louisville warehouse will serve 109 counties in Kentucky, southern Indiana and northern Tennessee. With Louisville, J&L will have nine general steel warehouses strategically located in steel-consuming areas. Besides Nashville, others are in New York, Chicago, Detroit, Memphis, New Orleans, Pittsburgh and Cincinnati.

NEARS COMPLETION OF SERVICE PLANT

▲ New building construction at its New York area steel service plant, which will increase capacity about 50 per cent, is nearing completion, it was announced by Joseph T. Ryerson & Son, Inc.

Located on an 8-acre site near the present plant at 203 Westside Avenue, Jersey City, N. J., the addition consists of two large building units, 110 ft by 605 ft, and 85 ft by 580 ft. Total floor area of the enlarged steel service facilities is about 355,000 sq ft, making this one of the largest operations of its kind in the East.

The addition will be used for improved service on structural steel, for greatly expanded reinforcing steel operations, and for the sheet and strip division. Space released when some operations now being performed in the main plant are moved to the new building, will be used for stocking additional steel products and a broader range of sizes of present products. New equipment to be installed includes machinery for sawing, shearing, and bending steel to customer's requirements.

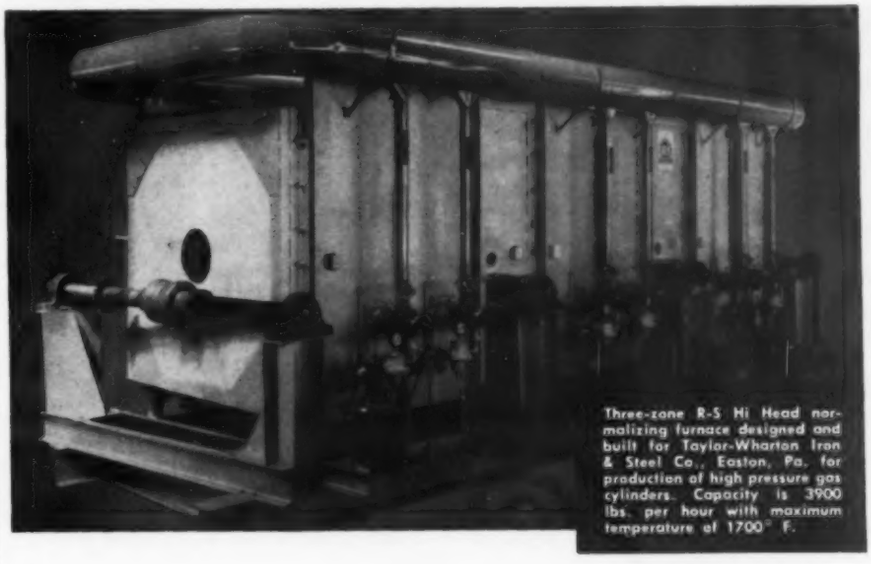
Steel handling and shipping facilities at the addition include two cranes in each building unit, a 40-ft truck driveway through the center of the building, and railroad sidings of the Central Railroad of New Jersey and the Lehigh Valley Railroad at either end of the plant. Offices will be provided for the reinforcing steel and sheet and strip divisions.

Present plans call for the new facilities to be functioning at least partially by January 1, 1954.

FOLLANSBEE TO BUILD CONNECTICUT WAREHOUSE

▲ To serve its New England customers better, Follansbee Steel Corp. has negotiated the purchase of an eight-acre site in Wallingford, Conn. The company plans to construct a new, modern warehouse on the site. Construction is expected to begin soon with completion about June 1, 1954.

Costing approximately $750,000, the one-story masonry and glass structure will comprise 54,000 sq ft, more than three times the size of the firm's present plant in Fairfield, Conn. The property will permit an eventual expansion to four times the area of the initial building. It fronts on U. S. Route 5, the major highway between Hartford and New Haven, and will be served by the New York, New Haven, and Hartford Railroad.



Three-zone R-S Hi Head normalizing furnace designed and built for Taylor-Wharton Iron & Steel Co., Easton, Pa. for production of high pressure gas cylinders. Capacity is 3900 lbs. per hour with maximum temperature of 1700° F.

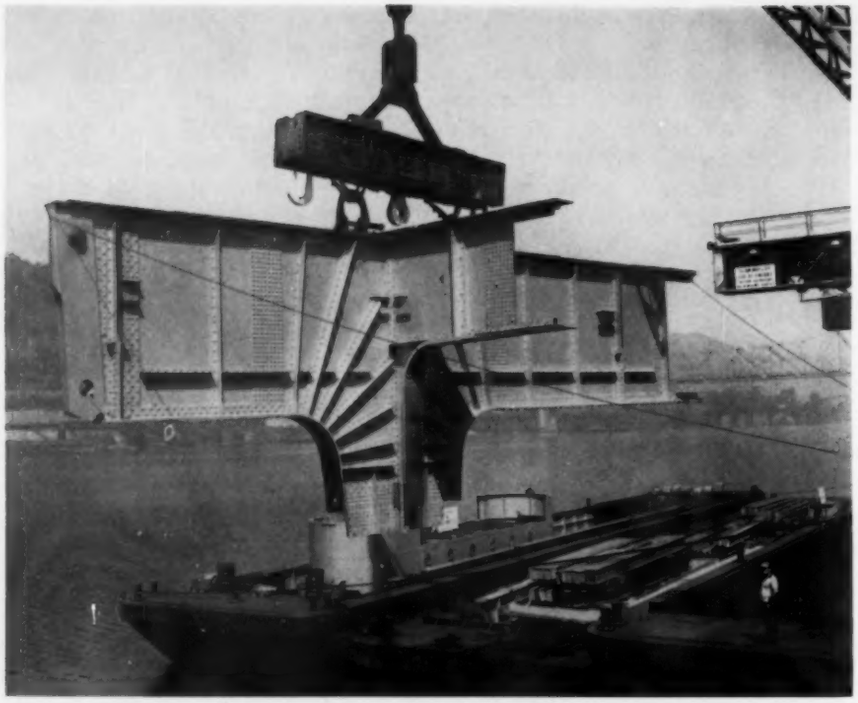
produces to Rigid Standards

Rigid Standards are met by the rapid and uniform heating. A steel billet 3½ inches square (regardless of length) can be heated to 2300° F. in 14 minutes with uniform heat conduction to the interior of the billet. The "wrap-around" action of the burning gases at high velocities and the high thermal head produce rapid heat transfer.

R-S FURNACE CORP.
4555 GERMANTOWN AVENUE
PHILADELPHIA 44, PENNSYLVANIA

A SUBSIDIARY OF
HARDINGE COMPANY, INC.

R-S
QUALITY FURNACES SINCE 1908



CHICKAMAUGA BRIDGE GIRDER WEIGHS ANCHOR

It might look like a boat from Mars to the residents along the Ohio River, but in reality this is a 34-ton star girder fabricated at U. S. Steel's American Bridge Division in Ambridge, Pa. It is being loaded into a river barge for shipment to the Chickamauga Dam Bridge for the Tennessee Valley Authority. This is the first of 18 girders of this type built for the new bridge now under construction. Unusual in design, the structure when completed will be one of the country's most beautiful bridges. A total of 4500 tons of structural steel will make up the 3458-ft bridge.

Customer service will be facilitated by 10-ton cranes, slitters, shears, edging rolls, and roller leveling and cut-up lines.

Follansbee Steel Corp. first went to Connecticut seven years ago when it located a warehouse in Fairfield. The location was used largely to serve users of strip steel, which is the firm's principal product.

BLISS CO. ACQUIRES DIE SUPPLY FIRM

▲E. W. Bliss Co., Canton, Ohio, announces the acquisition of the Die Supply Co., 1400 Brookpark Road, Cleveland, Ohio manufacturers and distributors of die makers supplies for the metalworking industry. Newly elected officers of the company include H. U. Herrick, president; J. H. Tredinnick, executive vice president; W. H. Garrison, treasurer and F. J. de Lorme, secretary. These four officers hold corresponding positions in the Bliss organization. Former Die Supply Co. officials who will continue with the organization include John R. Fitzsimmons, founder, who will continue as chairman of the board; War-

What's your problem in power motion?

There's an Anker-Holth cylinder to solve it!

• Advanced designs of Anker-Holth power cylinders in a wide range of sizes and types are available to solve your problems involving push, pull, lift or lowering action. If standard cylinders aren't the answer, Anker-Holth matches your needs with special designs.

For help in engineered cylinder power . . . air or hydraulic . . . write Anker-Holth Division of The Wellman Engineering Company, Dept. E-5, 2723 Conner St., Port Huron, Michigan.

***INFORMATION** on the complete line of Anker-Holth products is given in this bulletin. Free on request.*

Anker-Holth

ENGINEERED CYLINDER POWER

WELLMAN

Division of

THE WELLMAN ENGINEERING COMPANY

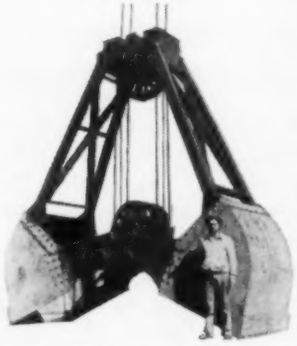
Wellman will build it

Special Cranes
Ore Bridges
Gas Producer Plants
Charging Machines
Forging Manipulators
Car Dumpers
Gas Flue Systems
Gas Reversing Valves
Coke Pushers
Mine Hoists
Skip Hoists
Clamshell Buckets

Wellman ore and coal handling bridges

give fast and efficient operation

One of two 6-ton Coal Handling Bridges in this installation.



6-ton Wellman Williams Type Coal Bucket used with these bridges.

● Take advantage of Wellman's long experience in designing and building handling bridges of many types and capacities. Your selection from the complete line will provide fast and efficient handling of coal or ore. Wellman equipment, in service the world over, is recognized for its long life and dependable service. It is backed by more than half a century of engineering experience.

THE WELLMAN ENGINEERING COMPANY

7000 CENTRAL AVENUE • CLEVELAND 4, OHIO

ren Fitzsimmons, formerly president, who will assume the duties of factory manager and Carl J. Theken, former comptroller, who will become assistant secretary and assistant treasurer.

BAR MILL OPERATIONS TO BEGIN AT FAIRLESS

▲ United States Steel Corp. announced that operation of bar mill facilities will begin at Fairless works, Fairless Hills, Pa., this month. Shipment of standard bars and small shapes and concrete reinforcing bars will be made in a limited volume and size range during the initial period of operation.

United States Steel concurrently announced the establishment of the following mill price bases for these products at Fairless works:

Carbon standard bars and small shapes, $4.30 per lb. Concrete reinforcing bars (new billet steel), $4.30 per lb.

These mill prices will be subject to the same lists of extras which are in effect at other United States Steel Corp. mills. These mill prices will result generally in substantially lower delivered prices to United States Steel Corp. customers located in the east coast market in comparison with prices now being paid for similar products shipped into this market from Pittsburgh and other United States Steel plant locations.

APPOINT YOUNGSTOWN DISTRICT AGENT

▲ Anker-Holth of Port Huron, Mich., division of Wellman Engineering Co., has announced a change of representatives in its Youngstown, Ohio, sales territory.

New representative will be the Paddon Co., a recently formed partnership of Don M. and Fred H. Paddon. They replace the F. J. Bowers Co. The change occurred when Frank J. Bowers retired from active representation. He has been retained on a consultant basis by the Paddon firm. Don M. Paddon was associated with the F. J. Bowers Co. for the past four years. Both he and Fred H. Paddon have many years experience in the steel industry as design engineers.

FOOTE BROTHERS OPENS WEST COAST OFFICE

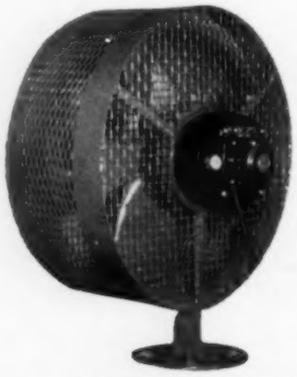
▲ To better accommodate west coast manufacturers, Foote Brothers Gear and Machine Corp., Chicago, Ill., has opened a new branch office for sales and service in California. It is located at 3529 Firestone Blvd., Southgate, a suburb of Los Angeles, and is under the direction of Robert E. Utermohlen.

INSTALL NEW GENERATOR UNIT AT RIVER ROUGE

▲ Installation of a new Air Products oxygen generator in the Ford Motor Co. River Rouge, Mich., steel plant, will increase Ford's high purity oxygen producing capacity of 30,000,000 cu ft a month. In all, Air Products, Inc., has four generators on lease to Ford.

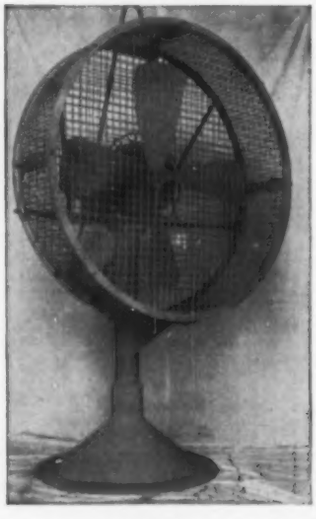
Air Products first leased four generators to the Ford company in June, 1947. Total oxygen producing capacity of the automobile manufacturer at that time was 16,000,000 cu ft a month. In February, 1949, two of the generators were replaced by units of higher capacity. Those replacement

IS HEAT SLOWING UP YOUR WORKMEN?



TRUFLO CRANE CAB FANS
For cooling interiors of crane cabs and other confined areas. Adjustable both horizontally and vertically. Four blade type, 12 and 18 in. sizes.

Keep them COOL with TRUFLO FANS



TRUFLO PORTABLE COOLING FANS
Easily portable. Help keep efficiency high where work is hottest. 12 to 36 inch diameters.

Production suffers when workmen are overheated. Steps begin to drag, efficiency falls.

Now, when speedy production is vital, Truflo Fans can help keep your workmen on their toes. All Truflo Fans are designed and built correctly to put fresh cool air *in large volumes* exactly where it is needed. Perfectly-balanced shafts and blades give more air per h.p. . . . strong steel frames stand up longer under hard use . . . rugged wire guards protect men against injuries.

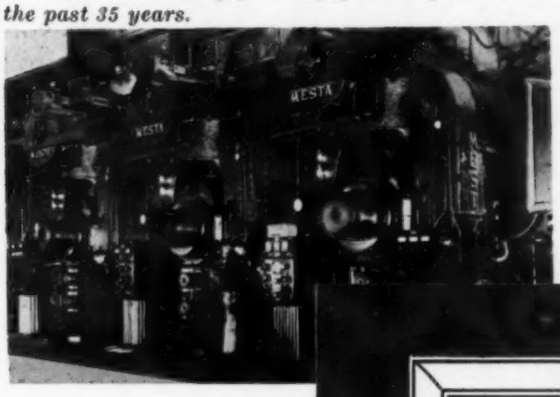
All of the following types can help beat the heat, keep production moving in your plant. Write for illustrated literature.

PORTABLE COOLING FANS
CRANE CAB FANS • WALL FANS
EXHAUST FANS • BLOWERS
ROOF VENTILATING FANS
PENT HOUSE FANS

TRUFLO FAN COMPANY

245 MAIN ST. HARMONY, PA.

MESTA "56" FOUR-STAND TANDEM COLD MILL, GRANITE CITY STEEL CO., GRANITE CITY, ILL. – *Another one of the more than 11,000 successfully completed electrical contracting jobs engaged in by F&M in the past 35 years.*



Another Electrical Installation by

FISCHBACH AND MOORE

INCORPORATED

"The Name to Remember..."

35 years of seasoned know-how have gone into making F and M *the* name to remember in the electrical contracting world. We look forward to demonstrating this proven experience in your service. You will find it invariably pays to utilize the full services and facilities of an acknowledged field leader.

FISCHBACH AND MOORE

INCORPORATED

ELECTRICAL CONTRACTORS

FROM COAST TO COAST *An organization that has to its credit every conceivable type of electrical installation.*

COMPLETE ORGANIZATIONS AT: *New York, Atlanta, Dallas, Houston, Los Angeles, San Francisco, Detroit, Chicago, Pittsburgh.*

MARTINDALE

MODEL 52 V.A.O. TESTER

This new, sturdy, portable instrument has 5" meter — Four testing ranges: Volts, AC and DC: 0-2.5-0-10.0-50, 0-250, 0-1000, Amperes, DC only: 0-10; Ohms: 0-1000, 0-10000; Megohms: 0-1, 0-100. Selector Switch provides four positions: Volts AC, Volts DC, Ohms, Amps. Range Switch has 5 positions which provide for above Voltage ranges, 4 ohm ranges, and 1 ampere range. 4' test lead has both prods and alligator clips. Has sturdy, leather carrying case.

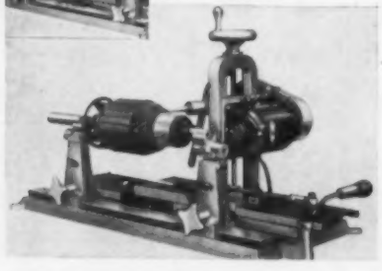
MARTINDALE GROWLERS

Portable Growler Type U-2

This universal adjustable growler can be used as an external growler for armatures (from 2" diam. up) and internal growler for stators (from 5¾" diam. up). 110 volt, 60 cycle. Write for prices on this and five other types.

BENCH-TYPE UNDERCUTTER

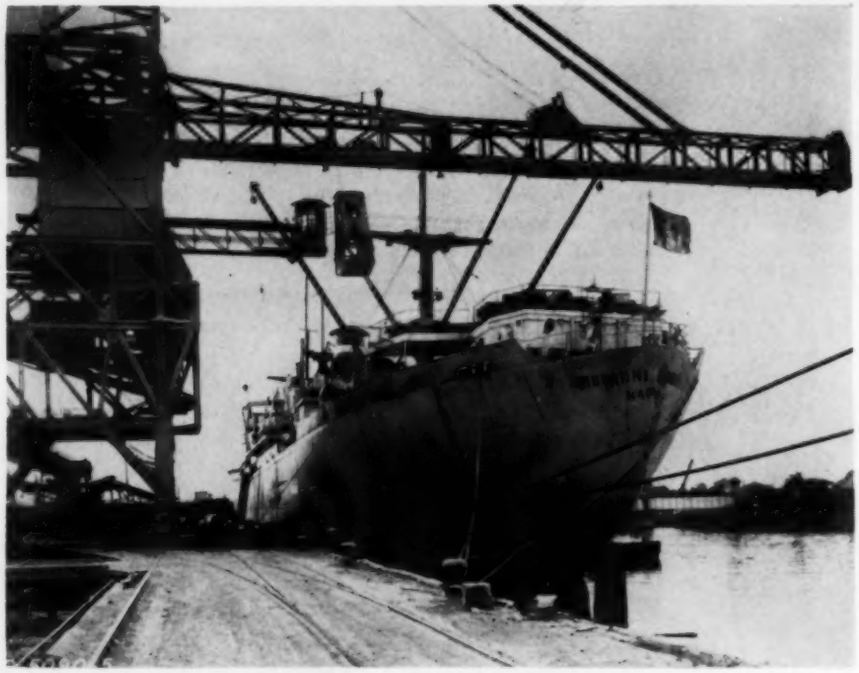
AT LEFT—Undercutting Vertical Commutator.
BELOW—Undercutting Horizontal Commutator. Note V-support at right raised to compensate for smaller shaft diameter.



Model HV-3 is a precision built, rugged, fast and accurate undercutter with a wider range of armature sizes and shaft lengths than any similar machine being built.

Write for new Catalog No. 29 of Electrical, Industrial and Maintenance Equipment.

MARTINDALE ELECTRIC CO.
1331 Hird Ave. Cleveland 7, Ohio



ORE WEIGHING SPEEDED UP AT MOBILE, ALA.

Clamshell buckets of ore are weighed by a new electrical method while moving from ship hold to the point of dumping at the Alabama State Docks, Mobile, Ala. By eliminating the necessity of stopping the bucket to weigh the ore handled by this Heyl & Patterson crane, its daily handling capacity was increased substantially. The loaded bucket is weighed by means of two Baldwin-Lima-Hamilton SR-4 load cells of 20,000 lb capacity each, which are mounted horizontally on the end of the boom that carries the bucket. The load is transmitted to the cells by wire ropes around two sheaves on a structural frame that is hung on pivots at the end of the boom.

generators increased Ford's total capacity to 26,000,000 cu ft a month. In the latest installation agreement one of the two remaining original generators will be replaced by a larger unit.

Under the agreement with the Ford Motor Co., the complete oxygen generating station except storage is furnished by Air Products. Because it is a lease arrangement, no capital investment is required by Ford.

FAN MANUFACTURERS FORM NEW ASSOCIATION

▲ The Power Fan Manufacturers' Association was formed in a meeting October 6 at Atlantic City, N. J. Formerly the Propeller Fan Manufacturers' Association, the new organization is a consolidation with a group of twelve power roof ventilator manufacturers. The new Association now has thirty-four members whose products cover axial fans, propeller fans, power roof ventilators, window kitchen and attic fans.

The primary purpose of the Association is to establish accurate delivery ratings so that the public may purchase with confidence. Other aims are the perfection of fan engineering, application to user's problems and to

develop markets. The members will undertake vigorous programs to attain these ends.

MID-WEST DEALERS ADD ROSS CARRIER LINE

▲Clark Equipment Co. has revamped its dealer organization in the midwest to handle its newly-acquired Ross straddle carriers and fork truck lines.

Clark dealers affected by the plan are Modern Handling Equipment, Inc., Chicago, Ill.; Materials Handling Equipment Corp., Cleveland, Ohio; Material Handling Sales Corp., Detroit, Mich.; and Wisconsin Industrial Truck Co., Inc., Milwaukee, Wisc. Under the new plan Clark dealers will add Ross products to their regular sales and service activities.

Clark acquired the Ross Carrier Co. earlier this year.

STRUTHERS-WELLS HOLDS PLANT TOUR

▲ Nearly 50 men representing 12 large manufacturers toured the plants of the Struthers-Wells Corp., Titusville, Pa., October 29 and 30, to see the corporation's line of unique metal forming machines.

The tour was arranged by the Rees Machinery Co. of Pittsburgh, Pa., which handles Struthers-Wells products throughout the region.

On both days, in addition to the plant tours, the representatives saw films and were guests of the Rees company at the Colonel Drake Hotel for luncheon and dinner.

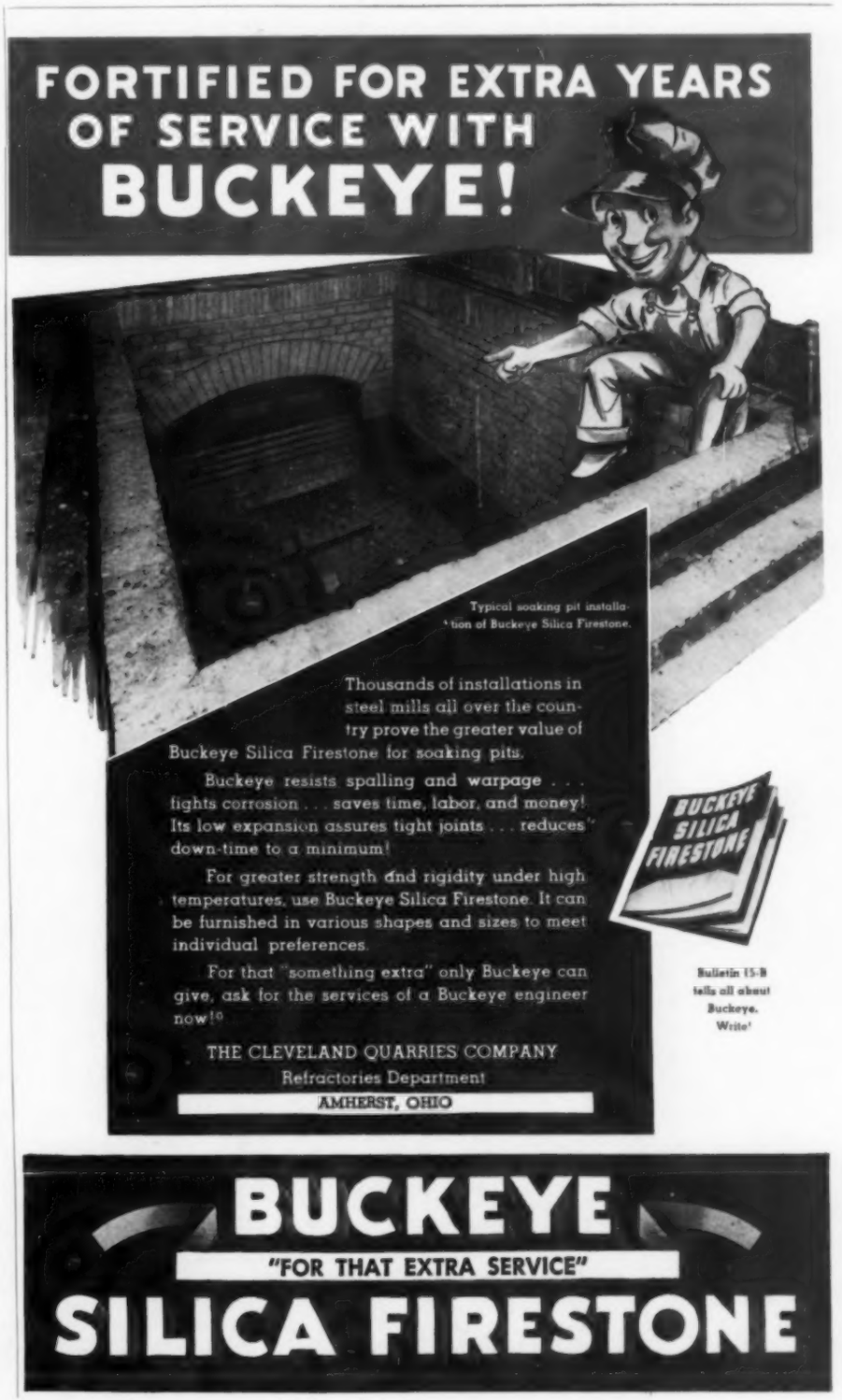
YALE & TOWNE OFFERS NEW FINANCIAL SERVICE

▲ A new, complete and flexible financing service for the sale and lease of industrial lift trucks was announced by Yale & Towne Manufacturing Co. This service has been instituted by the company in New York, N. Y., through a wholly owned subsidiary, The MHE Corp., and is now available to customers of Yale & Towne's Yale Materials Handling Division in Philadelphia, Pa., and the Automatic Transportation Co. in Chicago, Ill.

The new financing service, offers to those businesses and industries which do not wish to make the cash investment necessary for outright purchase, the opportunity to obtain Yale or Automatic materials handling equipment under a modern and economical financing plan. This will spread the advantages of materials handling equipment to many companies, large and small, whose purchases of industrial lift trucks have been postponed because of their necessity to conserve available capital funds.

The two principal features of Yale & Towne's new service are a "time sales" plan for the purchase of equipment by customers who wish to defer payments for as long as 36 months, as well as a "leasing" plan for those who desire to lease rather than purchase lift trucks. The plan permits leasing gas trucks from two to five years and electric trucks from two to nine years, and also provides options for either renewal or purchase.

Arrangements have been made for the field sales organization of Yale & Towne's two materials handling divisions to present the new leasing and time sales plans to potential users of Yale and Automatic industrial trucks.


FORTIFIED FOR EXTRA YEARS OF SERVICE WITH BUCKEYE!
Typical soaking pit installation of Buckeye Silica Firestone.
Thousands of installations in steel mills all over the country prove the greater value of Buckeye Silica Firestone for soaking pits.
Buckeye resists spalling and warpage . . . fights corrosion . . . saves time, labor, and money! Its low expansion assures tight joints . . . reduces down-time to a minimum!
For greater strength and rigidity under high temperatures, use Buckeye Silica Firestone. It can be furnished in various shapes and sizes to meet individual preferences.
For that "something extra" only Buckeye can give, ask for the services of a Buckeye engineer now!
THE CLEVELAND QUARRIES COMPANY
Refractories Department
AMHERST, OHIO
BUCKEYE SILICA FIRESTONE
Bulletin 15-B tells all about Buckeye. Write!
BUCKEYE
"FOR THAT EXTRA SERVICE"
SILICA FIRESTONE

Make it the Biggest Bonus ever— Give it in U.S. Savings Bonds

If your company is one of the more than 45,000 companies that have the Payroll Savings Plan you *know* what your employees think of Savings Bonds—they spell it out for you every month in their Savings Bond allotments.

If you don't have the Payroll Savings Plan, and are wondering whether your people would like to receive their bonus in Bonds, here are a few significant facts:

—every month, *before they get their pay checks or envelopes*—8,000,000 men and women enrolled in the Payroll Savings Plan invest $160,000,000 in U. S. Savings Bonds.

the ranks of Payroll Savers are growing: On June 30th sales of $25 and $50 Savings Bonds, the sizes purchased chiefly by Payroll Savers, were 6% and 9% higher than in the corresponding period of 1952.

—Payroll Savers hold their Bonds: 75% of the $7,400,000,000 Series E Bonds which had matured up to June 30, 1953, were being retained by their owners beyond maturity under the automatic extension program.

—on June 30, 1953, the *cash value* of Series E and H Bonds—the kind sold only to individuals—totaled $36,048,000,000, a new high.

It costs no more to give your Christmas Bonus in Savings Bonds. To the Payroll Saver, and to the man who buys his Bonds at a bank (because his company does not provide the Payroll Savings Plan) a One Hundred Dollar Savings Bond looks bigger and better than a check for $75. *Make this a merrier Christmas for every employee. Give the gift that keeps on giving.*

The United States Government does not pay for this advertising. The Treasury Department thanks, for their patriotic donation, the Advertising Council and

IRON AND STEEL ENGINEER

POOLE

A COPY OF CATALOG GIVING FULL DESCRIPTION AND ENGINEERING DATA SENT UPON REQUEST.

FLEXIBLE COUPLINGS

POOLE FOUNDRY & MACHINE COMPANY

WOODBERRY, BALTIMORE, MD.

PROGRESS REPORT ON NATIONAL CARBON
TRADE-MARK
BLAST FURNACE LININGS

One out of every *three* blast furnaces in this country is now lined with "National" carbon. With this outstanding acceptance of carbon as a blast furnace refractory, let's take a look at its remarkable performance over *the long haul*.

Here are the facts:

- *23* "National" carbon-lined furnaces have each produced over *2* million tons.
- *5* of these have passed the *2 1/2* million ton mark.

These are all original linings — *and still going strong!*

Every year more "National" carbon goes in... more unit tonnages go up and costs come down... more operators learn what *smooth* operation really is.

The term "National" is a registered trade-mark of Union Carbide and Carbon Corporation

NATIONAL CARBON COMPANY
A Division of Union Carbide and Carbon Corporation
30 East 42nd Street, New York, 17, N. Y.

District Sales Offices: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco

IN CANADA:
National Carbon Limited—Montreal, Toronto, Winnipeg

NATIONAL CARBON PRODUCTS

CARBON LININGS FOR FERRO-ALLOY FURNACES • CARBON MOLD PLUGS • GRAPHITE THERMOCOUPLE SHEATHS • GRAPHITE STARTERS FOR HOT-TOPPING • CARBON CINDER NOTCH PLUGS • GRAPHITE AND CARBON CORES • GRAPHITE RISER RODS • CARBON BOXES AND GRAPHITE POWDERS FOR HEAT-TREATING • PIPE AND FITTINGS • CARBON BRICK • PUMPS • CONDUCTOR ROLLS • SPECTROSCOPIC ELECTRODES • STEAM JETS • ANODES

Personnel News...

A. T. Lawson, vice president-general services since March of 1950, was named vice president-production of Jones and Laughlin Steel Corp., Pittsburgh, Pa. and was elected to the board of directors and the executive committee of the corporation. **Herbert Johnson,** vice president-Administration since June, 1953, was named vice president-general services to succeed Mr. Lawson. **Walter H. Lewis,** assistant vice president-production since June, 1953, was named works manager of the Pittsburgh works division. **William P. Getty,** assistant vice president-steel works, becomes assistant vice president-production. **E. K. Miller,** formerly vice-president-production, becomes consultant to the vice president-production. **Frank Cambest,** formerly works manager at Pittsburgh works, becomes assistant to the vice president-production. As a newly elected member of J&L's Board of directors, Mr. Lawson replaces **John B. Mitchell,** who retired as executive vice president-production in June of this year and who is now consultant to the president.

Charles H. Good, Jr., was promoted to assistant to general superintendent of the Duquesne, Pa., works of U. S. Steel Corp. Mr. Good has been assistant division superintendent, maintenance since March, 1951.

Clifford B. Brundage, Jr., has been named assistant division superintendent (rolling) at the Duquesne, Pa., works of U. S. Steel Corp. Mr. Brundage has been serving as assistant to general superintendent at the Duquesne plant.

Winfred M. Quigley was appointed assistant division superintendent (maintenance) at the Duquesne, Pa., plant of U. S. Steel Corp. Mr. Quigley was formerly general supervisor, maintenance department.

V. L. Nicoli has been appointed superintendent of the wire mill at the Buffalo, N. Y., plant of Colorado Fuel and Iron Corp.'s Wickwire Spencer Steel Division. Mr. Nicoli was formerly assistant superintendent of the wire mill. He joined the Buffalo plant's management staff in 1950, transferring from the South San Francisco, Calif., Works of the California Wire Cloth Corp., a division of Colorado Fuel and Iron. **L. P. McNamara,** formerly wire mill general foreman at the Buffalo plant, has been named assistant superintendent of the wire mill.

J. A. Heidish was named assistant manager of production for the wire and cable division of Copperweld Steel Co., Glassport, Pa. His previous assignment was superintendent of the casting department. During his 23 years with Copperweld, he also served as metallurgist and assistant chief metallurgist.

Robert C. Myers has been appointed director of product development, commercial department, United States Steel. In this newly activated position he will be responsible for the commercial phases of product planning and the development of new products. Mr. Myers will continue to operate in his capacity as director of market development of United States Steel.

Walter C. Stoner was appointed assistant superintendent of industrial relations at Republic Steel Corp.'s Youngstown, Ohio, steel plant. **John H. Mulcahy,** also assistant superintendent, will continue to serve in that post, which he assumed in 1950. Mr. Stoner was formerly superintendent of industrial relations at Republic's Truscon Steel Division in Youngstown.

Dr. Paul F. Chenea, who went to Purdue University last September from the University of Michigan to become professor of engineering mechanics and research professor of materials, was named as assistant dean of the five engineering schools of the university. In his new capacity, Dr. Chenea will assume such administrative duties as may be assigned by Dr. George A. Hawkins who became dean of engineering last July 1. He will also work in close association with Prof. W. Knapp, associate dean of engineering, in handling the administrative responsibilities of the engineering schools. Dr. Chenea also will continue his duties as head of the

A. T. LAWSON

CHARLES H. GOOD, JR.

CLIFFORD B. BRUNDAGE, JR.

WINFRED M. QUIGLEY

teaching and research work in engineering mechanics which is a division of the School of Civil Engineering and Engineering Mechanics.

Lorin L. Ferrall has been named assistant vice president of Crucible Steel Co. of America, Pittsburgh,

LORIN L. FERRALL

Pa. **David I. Dilworth, Jr.,** was appointed director of metallurgy. Mr. Ferrall will be assigned to the operating department and will report to the vice president in charge of operations. Mr. Ferrall formerly was the director of metallurgy. In announcing Mr. Dilworth's

DAVID I. DILWORTH, JR.

appointment, the company said that the central metallurgical department will now become a division of the operating department. Mr. Dilworth will report to the vice president in charge of operations, and will be located in Pittsburgh. Previous to his new assignment, he was assistant director of metallurgy.

George H. Schnake, Jr. was named advertising manager of the Ramtite Co., and its parent company, the S. Obermayer Co. at Chicago, Ill.

Thomas B. Newton was named manager of the marketing service department in the market development division of Lukens Steel Co., Coatesville, Pa. Mr. Newton joined the staff of the marketing service department in April, 1953.

Carl T. Miller has been appointed assistant treasurer of Mackintosh-Hemphill Co., Pittsburgh, Pa. Mr. Miller joined the company in February, 1953 after nine years employment with Ernst & Ernst.

Stephen Parey has been appointed assistant purchasing agent of the Cleveland, Ohio, and Pittsburgh, Pa., district of American Steel and Wire Division of U. S. Steel Corp. Mr. Parey had been serving as buyer for the Cleveland and Pittsburgh districts' purchasing division. Mr. Parey is located in Cleveland, Ohio.

Frank Long has become associated with the Cleveland, Ohio, office of E. W. Bliss Co. as a sales engineer. Prior to joining Bliss, Mr. Long was in military service, where he served in the Cleveland Ordnance District's regional offices in Akron, Cleveland and Toledo.

L. B. Abrams, Jr., has been named as sales engineer in the Pittsburgh, Pa., office of Dingle-Clark Co., to handle machinery sales. After service in the Navy, Mr.

L. B. ABRAMS, JR.

Abrams served in the Pittsburgh office of Ingersoll-Rand Co. In July, 1953, Mr. Abrams joined the Pittsburgh office of Dingle-Clark. In his new assignment, Mr. Abrams replaces **R. V. Robison** who has been named manager of the machinery division of Dingle-Clark in Cleveland, Ohio.

William H. Campbell has been elected treasurer and assistant secretary of Elwell-Parker Electric Co., Cleveland, Ohio. Mr. Campbell succeeds **William E. Hornig,** who held that position for 13 years and is leaving to become controller of Midland Steel Products Co., Cleveland. Mr. Campbell previously held the position of assistant controller for Willard Storage Battery Co.

Edwin E. Caspell, who has been works superintendent at the New Haven, Conn., plant, of American Steel and Wire division of U. S. Steel Corp. is appointed general superintendent of the New Haven, Conn., and Trenton, N. J., plants. Succeeding Mr. Caspell as superintendent of New Haven works is **John J. Grimes, Jr.,** who has been superintendent of the wire rope department at the Trenton plant. Mr. Caspell succeeds

200-ton 6-motor 98'-3" Span Crane with two 100-ton Hoists and one auxiliary 10-ton Hoist. In Concentrator Grinding Bay.

DESIGNERS • MANUFACTURERS • CONTRACTORS

BLOOMING MILLS • PLATE MILLS • STRUCTURAL MILLS • ELECTRIC TRAVELING CRANES • CHARGING MACHINES • INGOT STRIPPING MACHINES • SOAKING PIT CRANES • ELECTRIC WELDED FABRICATION • LADLE CRANES • STEAM HAMMERS STEAM HYDRAULIC FORGING PRESSES • SPECIAL MACHINERY FOR STEEL MILLS

BUILT BY MORGAN Engineering

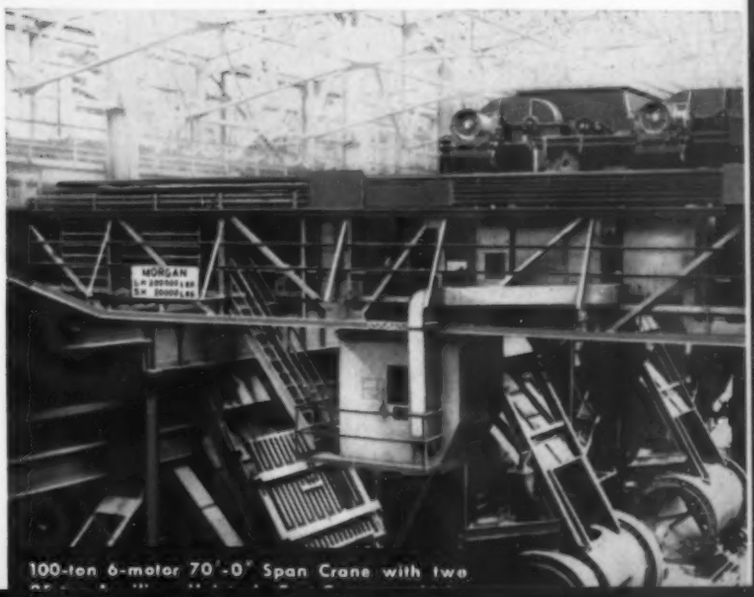
MORGAN CRANES AT "CHUQUI"

Illustrated are three Morgan Heavy Duty Mill Type Cranes at Chile Exploration Company's new plant at Chuquicamata. These cranes are of very rugged construction, especially designed for copper smelter service. *Your inquiries will be appreciated.*

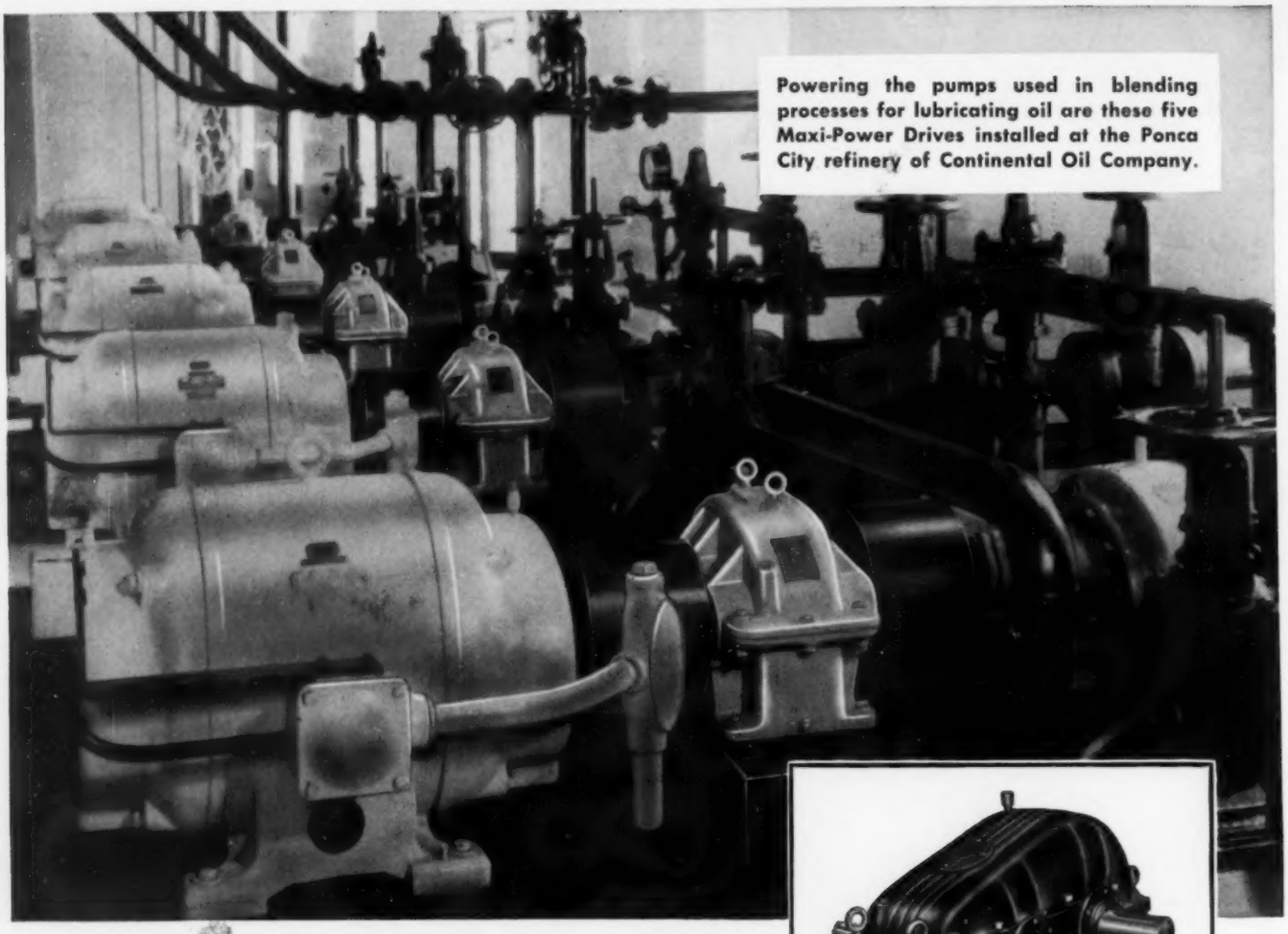
THE MORGAN ENGINEERING CO.

ALLIANCE, OHIO PITTSBURGH—1420 OLIVER BUILDING

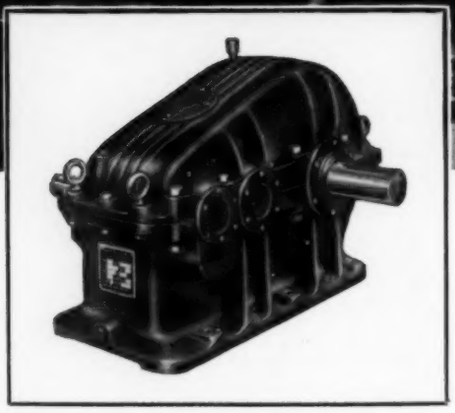
100-ton 6-motor 70'-0" Span Crane with two



100-ton 6-motor 70'-0" Span Crane with two



Powering the pumps used in blending processes for lubricating oil are these five Maxi-Power Drives installed at the Ponca City refinery of Continental Oil Company.



MAXI-POWER

They Thrive on Heavy Duty

This Trademark Stands for the Finest in Industrial Gearing

Any drive will do a good job the first day, but how will the record read after a month — a year — five years?

Will it — like Foote Bros. Maxi-Power Drives — still have the stamina to handle high horsepowers for hardest, day-after-day service? Will its maintenance costs remain low? Will efficiency still approach 100%?

And when you're deciding on a drive, is space a crucial factor? Maxi-Power's superior gearing is designed into the most compact housing to assure maximum load-carrying capacity in minimum space for heavy-duty units.

Sturdy — reliable — Maxi-Power Drives provide years of better performance for the most rugged applications. Available with single, double or triple reductions in sizes to meet your requirements. Ratios range up to 360 to 1, capacities up to 1,550 h.p.

Line-O-Power Drives

Foote Bros.-Louis Allis Gearmotors

Hygrade Drives

FOOTE BROS.

Better Power Transmission Through Better Gears

Call your Foote Bros. representative, or write for detailed information.

FOOTE BROS. GEAR AND MACHINE CORPORATION
Dept. IAS, 4545 South Western Boulevard, Chicago 9, Illinois

Please send Bulletin MPB containing full information about heavy-duty Maxi-Power Drives.

Name.....

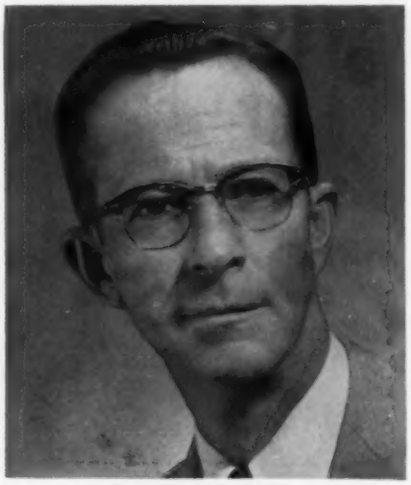
Company.....

Address.....

City.....Zone.....State.....

Stephen B. Metcalfe, appointed assistant district manager of operations of the Worcester, Mass., district.

Jack Beaudoin, has been promoted to assistant superintendent of the electrical maintenance department at Kaiser Steel Corp., Fontana, Calif. Since he joined the company as construction electrician in December, 1942,



JACK BEAUDOIN

Mr. Beaudoin has served as electrical general foreman of the rolling mills and has handled other maintenance assignments in this field until his appointment as chief electrician in May, 1951.

Stephen B. Metcalfe has been appointed assistant district manager of operations of the Worcester, Mass., district of American Steel & Wire Division of U. S. Steel

STEPHEN B. METCALFE

Corp. Mr. Metcalfe was promoted from the position of general superintendent of the wire division's plants in New Haven, Conn., and in Trenton, N. J.

William G. Arnold has been appointed manager of manufacturing for General Electric Co.'s conduit products department. Mr. Arnold was previously manager of the New Kensington, Pa., plant of the conduit products department. In his new position, he will be responsible for all phases of the department's manufacturing operations at both the New Kensington and Bridgeport, Conn., plants. Mr. Arnold's office will be located at New Kensington.

John W. Jordan was named assistant to executive vice president-accounting, United States Steel Corp. Mr. Jordan was assistant comptroller of U. S. Steel's American Steel and Wire Division in Cleveland. After joining U. S. Steel in 1933 as a fuel and power engineer at the Clairton Works, Mr. Jordan was employed at several different plants in the company's Pittsburgh and Chicago districts. Before moving to Cleveland in 1943 as cost planning supervisor for American Steel and Wire, he was a Carnegie-Illinois staff industrial engineer in Pittsburgh.

John J. Appleyard has been appointed director of public relations, Philadelphia district of United States Steel Corp. United States Steel is establishing this new public relations district because of the rapidly expanding industrial community in Philadelphia and the Delaware Valley. Headquarters will be located in the near future in the Broad Street Suburban Station

JOHN J. APPLEYARD

Building, Philadelphia, Pa. The present public relations field office at Fairless works, in Fairless Hills, Pa., will continue in active operation and maintain close liaison with the Philadelphia district office. Mr. Appleyard has been serving as public relations representative at Fairless works.

Paul W. Arnold and **Charles R. Sutherland,** were elevated to newly-created key positions at Reliance Electric and Engineering Co.'s Cleveland, Ohio, headquarters. Mr. Arnold, formerly executive assistant to the sales vice president, becomes manager of marketing services. Mr. Sutherland, formerly manager of large motor engineering, becomes assistant chief engineer.

G. T. Collatz has been named sales representative for American Flexible Coupling Co. in its New England territory. He will continue to represent The Cleveland Worm & Gear Co. and the Farval Corp. in the same district.

Floryan J. Tokar has been named exclusive representative for the territory covering northern and central Illinois, northern Indiana, Wisconsin and eastern Iowa for Charles Taylor Sons Co. Mr. Tokar was for several years with Bethlehem Steel Co. and U. S. Steel Corp. After military service he was employed by Gen-

eral Refractories Co., Standard Steel Works of Baldwin-Lima-Hamilton Corp. and the Quigley Co. Mr. Tokar will maintain an office in Chicago, Ill.

Robert J. Bodeman has been transferred to the Chicago, Ill., sales office from Harbison-Walker Refractories Co.'s basic sales department in Pittsburgh, Pa. **Ernest C. Ullom,** formerly a salesman in the Buffalo, N. Y., District, has been transferred to Harbison-Walker's New York, N. Y., sales office.

Laurence Young, general electrical foreman of Kaiser Steel Corp.'s tin plate mill , at Fontana, Calif., has been appointed chief electrician of the steel plant. Mr.

LAURENCE YOUNG

Young joined the company in 1942 to perform electrical construction. In 1944, he was made foreman of the electrical shop. His appointment in the tin plate mill responsibility occurred in 1951.

L. W. Bramlett was appointed superintendent of the electrical maintenance department of Lone Star Steel Co., Lone Star, Tex., on September 1. Prior to joining

L. W. BRAMLETT

Lone Star, Mr. Bramlett was electrical and mechanical supervisor for Green River Steel Corp. and is a veteran in the industry having spent 27 years with the Republic Steel Corp., southern district, from 1925 to 1952, where he started as apprentice electrician and rose to chief electrician of the Thomas plant.

George A. Hinckley was named sales manager, Automatic, of the Automatic Transportation Co., Chicago, Ill. For the past three years Mr. Hinckley has been sales

GEORGE A. HINCKLEY

manager for Automatic's New York, N. Y., factory branch. Prior to that he was with the sales department at the home office in Chicago. Mr. Hinckley succeeds **Robert M. Whitney,** who has advanced to national advertising and promotion manager of Yale and Towne Manufacturing Co., New York, of which Automatic is a division.

G. Clymer Brooke has been elected executive vice president of the Birdsboro Steel Foundry and Machine Co., Birdsboro, Pa. Before his appointment by the board of directors, Mr. Brooke was vice president of the company.

K. J. Kettner was appointed district manager for the Ramtite Co. in the northeastern Ohio district. Mr. Kettner, located in Youngstown, Ohio, has been with the Ramtite Co., since 1946.

Harold G. Leibold has been elected a director of Silica Chemical's, Inc., a newly formed subsidiary of Cleveland Quarries Co. Mr. Leibold has had eighteen years service as a sales engineer and as manager of refractory sales of the parent company. **George S. Love** was named secretary-treasurer of the new company. Mr. Love has been with Cleveland Quarries Co. twenty-five years and has served as auditor, controller, and assistant secretary.

Obituaries

J. Paul Bindyke, 57, a metallurgical engineer for Heppenstall Co., Pittsburgh, Pa., for nearly 35 years, died October 25, 1953.

Albert P. Short, 60, district representative for Chas. Taylor Sons Co., a subsidiary of National Lead Co., Cincinnati, Ohio, manufacturers of special refractories, died September 22 at Beech Haven, N. J.

You can't beat **Ohio Magnets** for **performance**

Morning . . . noon . . . night—Ohio Magnets lift uniformly larger loads over extended periods because they operate *cooler.*

Take this husky Ohio Bolted Magnet, for instance. Heavy-duty strap-wound copper coils are protected by longer-lasting inorganic insulation carefully sealed with non-remelting or asphaltum compound.

For extra magnet performance, extra magnet value—specify Ohio Magnets. Remember, Ohio Magnets lift larger loads longer—*especially with Ohio Magnet Controllers.* Send for Bulletin 112. Offices in principal cities listed in Classified Directory.

OHIO
OHIO WELDED MAGNETS. 39 to 65" diameter. Lightweight models in 39 & 45". 6-coil types in 46, 55, 65"; 8-coil in 55 & 65". Weld on top where it can't get dented in. Also capsule coil over 45".
OHIO BOLTED MAGNETS. 12 to 65" diameter. 6-coil types in 39 to 65"; 8-coil in 55 & 65". Strap copper coils over 39". Bolts protected in recessed wells. Also capsule coil over 45".
OHIO BASKET MAGNETS. 55 & 65" 4-coil, & 65" 6-coil. For extra heavy-duty service; hefty ears project beyond magnet diameter, ward off damaging blows. No weight carried by bolts. Also capsule coil over 45".
A-7301

ohio ELECTRIC

CHESTER BLAND
President

THE OHIO ELECTRIC MFG. CO.
5400 DUNHAM RD. • CLEVELAND, OHIO

Ohio Also Makes Separation Magnets • Heavy-Duty Electric Hoists • Nail Making Machines • Fractional Horsepower, Shell and Torque Motors • Precision Threaded Parts for Aircraft Engine Manufacturers

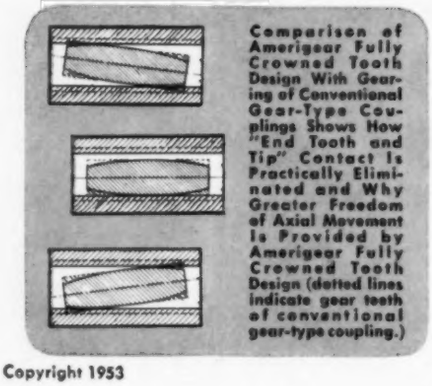
THE Amerigear* FULLY CROWNED TOOTH DESIGN

practically eliminates "End Tooth and Tip" contact . . . gives greater freedom of axial movement

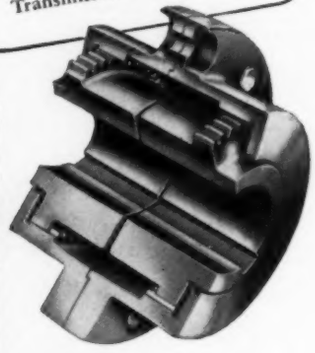
Crowned Tip Contacts Root of Internal Gear Tooth in Sleeve, Accurately Piloting Sleeve with a Ball and Socket Action.
Chamfered to Eliminate Interference with Sleeve Tooth Fillet and Allow Contact on True Flank of Gear Tooth.
Crowned Flank Carries All the Load and Provides for Correction of Lateral and Angular Misalignment Conditions.
A MAJOR IMPROVEMENT IN GEARING

Amerigear*
Fully Crowned Tooth Design Solves Wide Range of Power Transmission Problems.

Pat. & Pat. Pending



Comparison of Amerigear Fully Crowned Tooth Design With Gearing of Conventional Gear-Type Couplings Shows How "End Tooth and Tip" Contact Is Practically Eliminated and Why Greater Freedom of Axial Movement Is Provided by Amerigear Fully Crowned Tooth Design (dotted lines indicate gear teeth of conventional gear-type coupling.)



Oil Seals of Amerigear Couplings Are As Advanced in Design, Performance, and Effectiveness As Is the Amerigear Fully Crowned Tooth.

This major improvement in gearing—a fundamental improvement in gear tooth design results in these advantages: (1) Relief from extraneous stresses; (2) Crowned flanks providing for angular and lateral misalignment with back lash reduced to a minimum; (3) Torque load carried on flanks of teeth rather than on tooth edges; (4) Greater loads and higher speeds with corresponding longer life for coupling and equipment; (5) Close fit on crowned tips and flanks of teeth, inducing a ball and socket action between hub teeth and internal sleeve teeth, assure quiet and smooth performance. These advantages distinguish the Amerigear Couplings from common gear-type couplings. If your problem arises from excessive offset or angular misalignment, tight back lash requirement, space limitations, high speeds and loads, or any combination of these, the best solution is assured by use of the Amerigear Couplings with the Fully Crowned Teeth. Amerigear Engineers are available for consultation.

*Trade Mark Reg.

Copyright 1953

AMERICAN FLEXIBLE COUPLING COMPANY

ERIE, PA., U. S. A. *Originator of the Amerigear Fully Crowned Tooth*

Sales Offices in Principal Industrial Centers

In Canada: Canadian Zurn Engineering, Ltd. • 2052 St. Catherine St. W., Montreal 25, P. Q.

American Flexible Coupling Co., Erie, Pa., U. S. A.

Please send me further information regarding AMERIGEAR COUPLINGS with the Fully Crowned Teeth and Catalog No. 501.

Name ..... *Title* .....

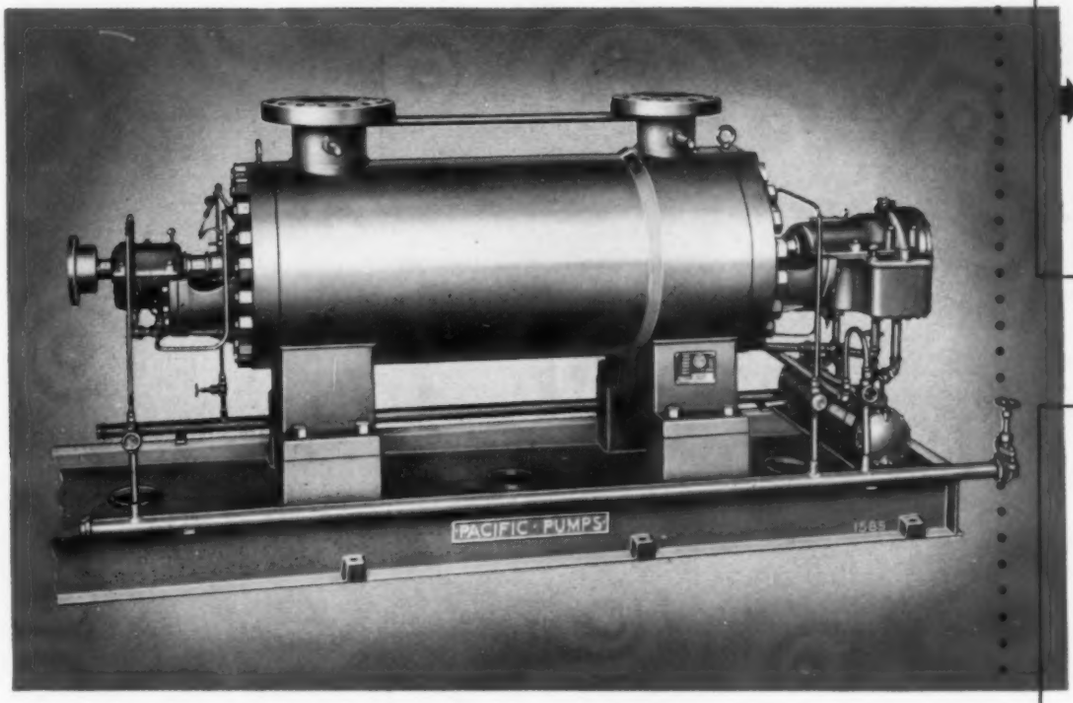
Company .....

Address .....

City ..... *State* .....

Please attach to your business letterhead.

What will Pacific CENTRIFUGAL PUMPS *do for you?*



THE NEW
New impeller ready for installation.

THE WORN
Impeller after 11 years' service.

● *They will last and last . . . give you years of trouble free service!* Pacifics are built in types to meet your requirements . . . they will deliver up to 2700 gallons per minute of cold or hot water at discharge pressures up to 3000 pounds per square inch.

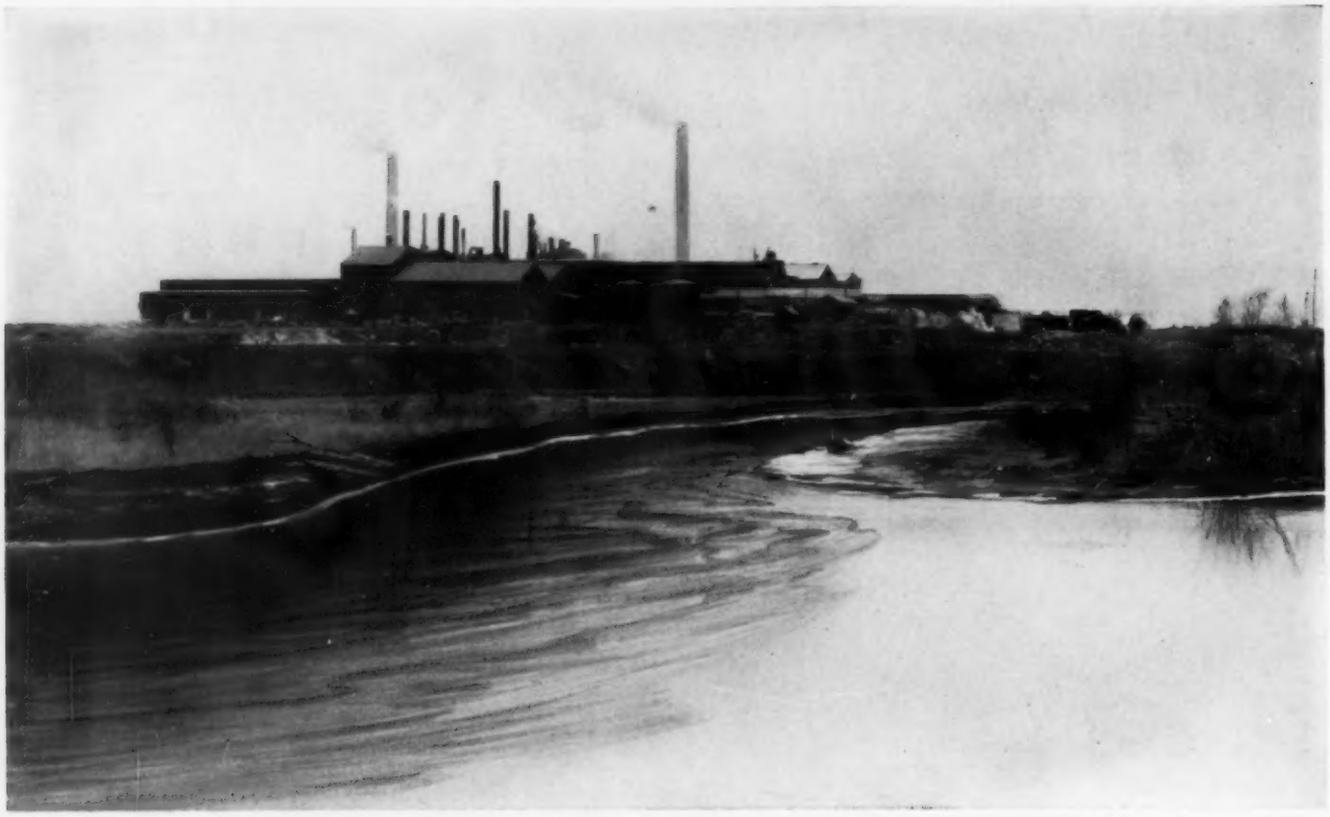
Their strength and toughness is created by using carbon and alloy steels. The bearings for multi-stage pumps are pressure lubricated. Bearings for all types are sealed against dust and dirt. The result is less down time, fewer replacements and much longer pump life. Pacific Pumps *set new service records*—time after time.

PACIFIC *Precision Built* PUMPS

Pacific Pumps Inc.
ONE OF THE DRESSER INDUSTRIES

HUNTINGTON PARK, CALIFORNIA
Export Office: Chanin Bldg., 122 E. 42nd St., New York—

15-1



WORRIED ABOUT WASTE DISPOSAL?

Bailey Meters Help you to Reduce Pollution

● The disposal of industrial wastes without stream pollution calls for careful planning and continuous vigilance.

That's where Bailey Meters and Controls come in. We measure the flow and pH of sewage, sludge, and industrial wastes flowing in open channels or pipe lines. These and other factors, such as levels, rates of chemical feed, and flow of air, may be co-ordinated into a completely automatic system for the treatment and disposal of waste materials.

When you want fast, complete and authoritative answers to the measurement and control aspects of your waste disposal problems, reach for your phone and call your local Bailey Engineer. Offices in all principal industrial centers.

P-24

BAILEY
OPEN CHANNEL METERS

These indicating, recording and integrating meters are suitable for measuring industrial wastes, sewage, sludge, corrosive liquids, and irrigation water flowing in all types of open channel primary metering devices, such as Venturi flumes, weirs, or nozzle flumes. Electric or pneumatic telemetering permits location of receivers wherever desired. Ratio of flows and chemical feeds may be controlled automatically.

BAILEY METERS

BAILEY METER COMPANY

1047 IVANHOE ROAD
CLEVELAND 10, OHIO

Process Controls
TEMPERATURE · FLOW
PRESSURE · LEVEL
GAS ANALYSIS · RATIO

These two man trolley type unloaders, built by Dravo Corporation, are part of the materials handling equipment at the dock of United States Steel Corporation's new Fairless Works near Morrisville, Penna.

The two unloaders run parallel on a common runway for a distance of 1,000 feet. Each unloader is built to handle a 200-cu. ft. ore bucket or a 300-cu. ft. coal bucket. Coal or ore can be unloaded to railroad cars, to pit storage or to a conveyor belt.

DRAVO

DESIGNERS *and* BUILDERS

BRIDGES AND UNLOADERS • TOWER-TYPE UNLOADERS
WHIRLER CRANES • FLOATING CRANES
DRAVO RAIL CLAMPS • BARGE SHIFTERS
MODERNIZED TROLLEYS FOR EXISTING BRIDGES

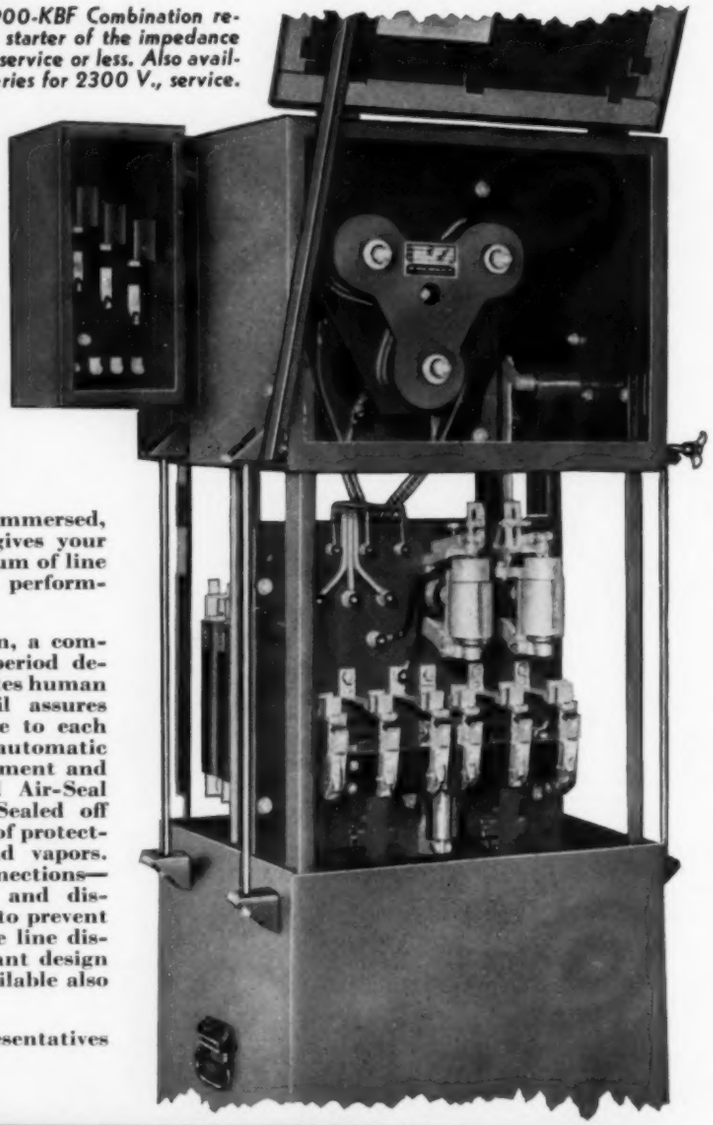
Why not make use of Dravo's more than 60 years of practical experience in the engineering field when planning your next heavy materials handling project?

DRAVO
CORPORATION
NEVILLE ISLAND, PITTSBURGH 25, PENNSYLVANIA

AIR CONDITIONING • BOILER AND POWER PLANTS • CRANE CAB COOLERS • DOCKS • INDUSTRIAL FOUNDATIONS • OPEN STEEL FLOORING
PUMP HOUSES AND INTAKES • SPACE HEATERS • WATER AND WASTE TREATMENT PLANTS • TOWBOATS AND BARGES

Oil Immersed

Rowan Type 900-KBF Combination reduced voltage starter of the impedance type, 600 V., service or less. Also available in 950 series for 2300 V., service.



ROWAN

Type 900 Series

REDUCED VOLTAGE STARTER

Push button operated—fully automatic—this oil immersed, reduced voltage starter of the impedance type gives your induction motors a smo-o-oth start with a minimum of line disturbance. Check its design, construction, and performance features:

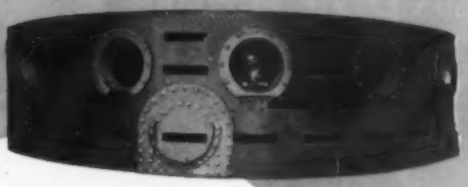
√ Closed transition type—utilizes for acceleration, a combination of current and time. √ Acceleration period dependent upon driven equipment and load—eliminates human element. √ Continuous wound impedance coil assures freedom from tap failures—impedance adjustable to each application. √ Magnetic overload relays with automatic reset—provides a combination of inverse time element and instantaneous operation. √ Rowan time-tested Air-Seal fuses—dependable short circuit protection. √ Sealed off centralized wiring compartment—eliminates need of protecting incoming and outgoing leads from oil and vapors. √Provision for straight through conduit connections—facilitates installation and inspection. √Tank and disconnect mechanism is mechanically interlocked—to prevent the lowering of the tank before disconnecting the line disconnect switch. √ Enclosure is of weather-resistant design to meet the requirements of NEMA Type XI—available also for Class I Group D locations.

Complete information available from Rowan representatives in principal cities of the United States.

ROWAN CONTROL

THE ROWAN CONTROLLER CO., BALTIMORE, MD.

Furnace top ring, cone and platform.



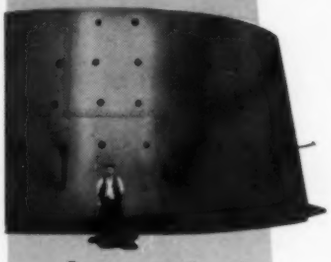
Tuyere jacket

"STANDARD BOILER"

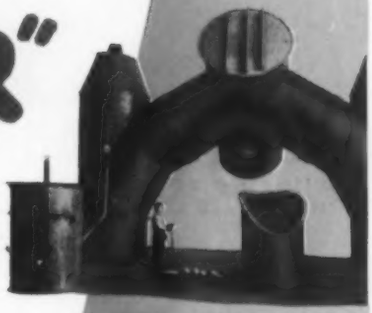
Industry's Headquarters for *Dependable*

STEEL MILL FURNACE CONSTRUCTION AND FABRICATION

for over 40 years!



Furnace mantle and first two rings of shell



Uptakes and downcomer connection.

Assembled stove bottom.

Furnace top cone and off-takes

Hot blast stove dome.

Bustle pipe and platform.

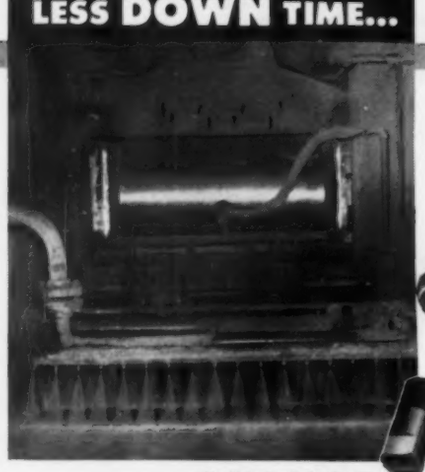
STANDARD BOILER & PLATE IRON COMPANY

C. A. BRASSERT, *President*

ENGINEERS
FABRICATORS
ERECTORS

General Offices: Union Bank Bldg.
Pittsburgh 22, Pa.
SHOPS at NILES, OHIO

LESS DOWN TIME...



STRAINER

CAP

LARGE DIAMETER ORIFICE

when you CHANGE over to SPRAYING SYSTEMS descaling NOZZLES

If you want to materially reduce down time on rolling mills due to clogged nozzles, try Spraying Systems descaling nozzles. Large orifice diameter permits passage of practically all particles that ordinarily clog other types of nozzles. Spraying Systems nozzles produce an effective uniform flat spray, free of streaks, with an impinging force equal to over 96% of the maximum potential. Typical user is the Homestead District Works of U. S. Steel illustrated above. Nozzles are made of hardened stainless steel in a wide range of capacities and spray angles. Your inquiry is invited . . . write for Data Sheet 3997.

SPRAYING SYSTEMS CO.

3262 RANDOLPH STREET • BELLWOOD, ILLINOIS

Also write for Data Sheet 4516 . . . Pneumatic Atomizing Nozzles for direct spray gear lubrication.

Superior BLAST FURNACE COPPER CASTINGS

Cooling Plates of all kinds including Heavy Nose Super Cooled Bosh Plates.
Hot Blast Valves and Valve Seats
Blast Furnace Tuyeres. Licensed Manufacturers of all Leading Designs

SMEETH-HARWOOD COMPANY

8524 Vincennes Ave., Chicago 20, Ill.

In Canada—The William Kennedy & Sons, Ltd., Owen Sound, Ontario

Blast Furnace Copper Castings—also Brass and Bronze Mill Castings

ONE MAN HANDLES IT EASILY

FARNCO
ALL ALUMINUM CONVEYOR

Built to reach inaccessible places, carries brick, sand, flu dust, wet concrete. Can be used in multiple units for long hauls.

POWERED BY AIR GAS or ELECTRIC

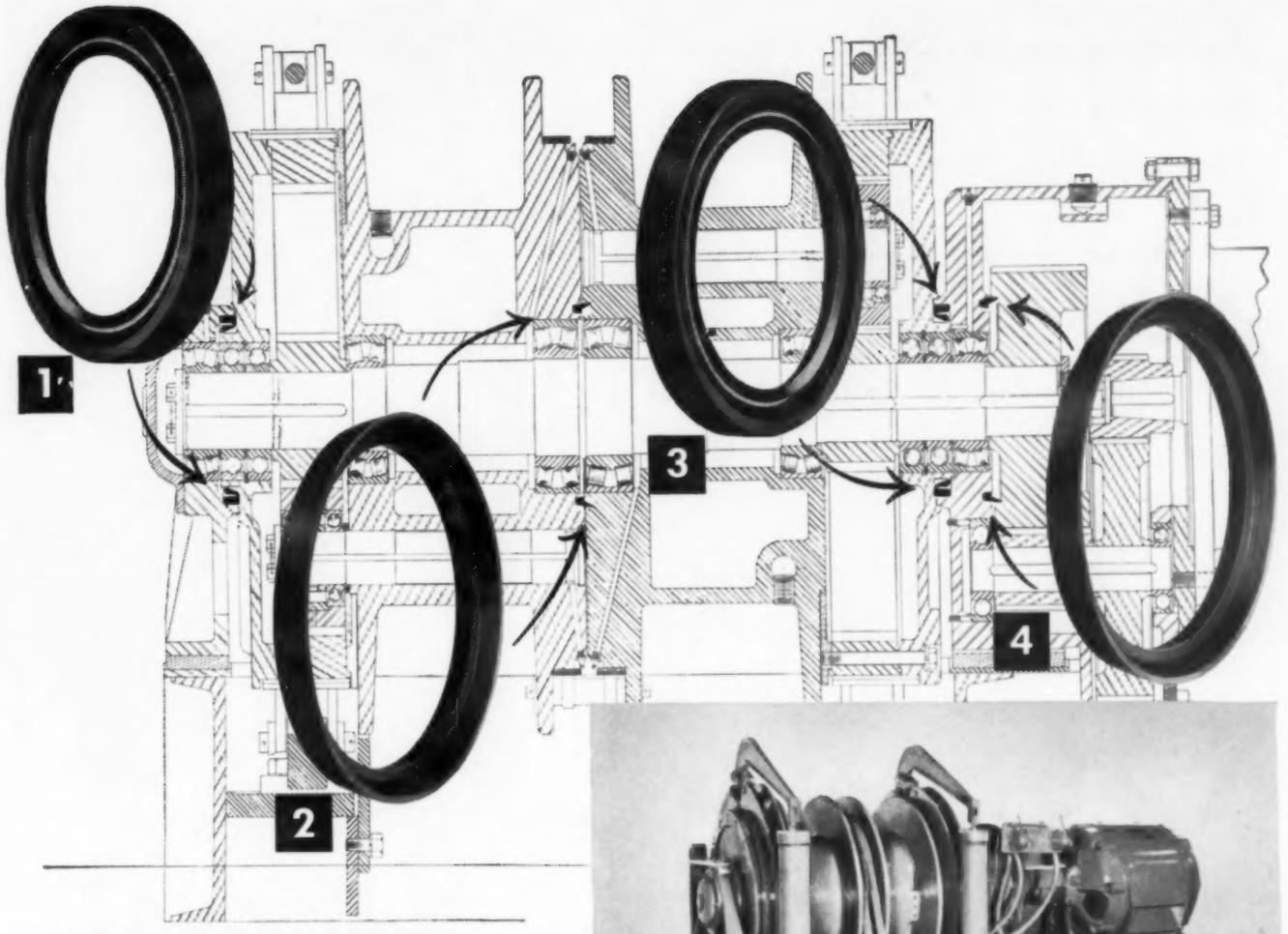
Built of **STRONGEST, TOUGHEST,** aluminum Designed and manufactured by precision engineers who specialize in close tolerances. **SAVES MANPOWER SAVES $ $**

NATIONAL DISTRIBUTORS

FARNCO SALES CO.

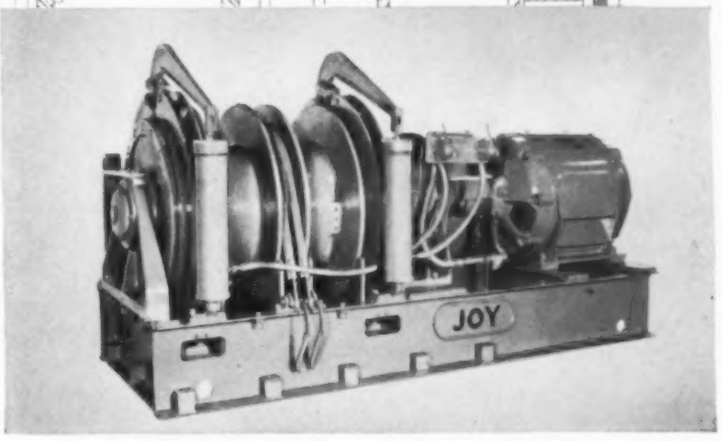
PITTSBURGH 8, PA., P. O. Box 5796, Phone EMerson 1-7602

Get our illustrated literature, HOW it operates. →



A TYPE OF OIL SEAL FOR EVERY SERVICE

The J-M Clipper Seals used in Joy Manufacturing Company's Double Drum Slusher Hoists are: (1) Type LPD for planetary clutch-hub to bearing-bracket seal, (2) Special Outside Lip Seal Between counter-rotating drums, (3) Type LPD seal as reduction gear housing to planetary clutch-hub seal, (4) Special Outside Lip seal for reduction gear housing seal.



Need an oil seal to withstand muck and acid mine water?

Clipper Oil Seals help Joy Mine Slushers stay underground longer

THIS 125 H.P. Double Drum Slusher Hoist made by Joy Manufacturing Company is one of the most rugged machines in underground mining service. Designed to haul rock and ore in metal mining operations, it is constantly covered with muck and mud. In addition it is subjected to acid mine waters. To work dependably, shift after shift, day after day, it must stay clean and well lubricated on the inside.

To protect its bearings from dirt and corrosion and to retain the lubricant, two types of Clipper Seals are used. Type LPD Clipper Seals with corrosion-resistant alloy garter springs are installed on the reduction gear housing to planetary clutch and on the planetary clutch hub to bearing housing. Special outside lip springless Clipper Seals are installed between the counter rotating drums and on the reduction gear housing. This combination was effected by Johns-Manville Packing Engineers working in conjunction with the Joy Manufacturing Company engineering staff.

Clipper Seals offer many advantages, wherever accurate fit, longer life and greater sealing effectiveness are required. These precision-moulded oil seals provide easy installation, because the tough, dense heel affords just the right amount of rigidity for a press fit in the cavity . . . while the flexible lip, held in light but positive contact with the shaft by an especially designed garter spring, provides effective sealing at all times.

Clipper Seals come in a wide variety of designs, to meet practically any sealing requirement. For details write Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay St., Toronto 1, Ont.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville CLIPPER OIL SEALS

Every Man Who Wants to Get Rid of Misalignment Headaches Should

SEND FOR THESE NEW

AJAX DIHEDRAL

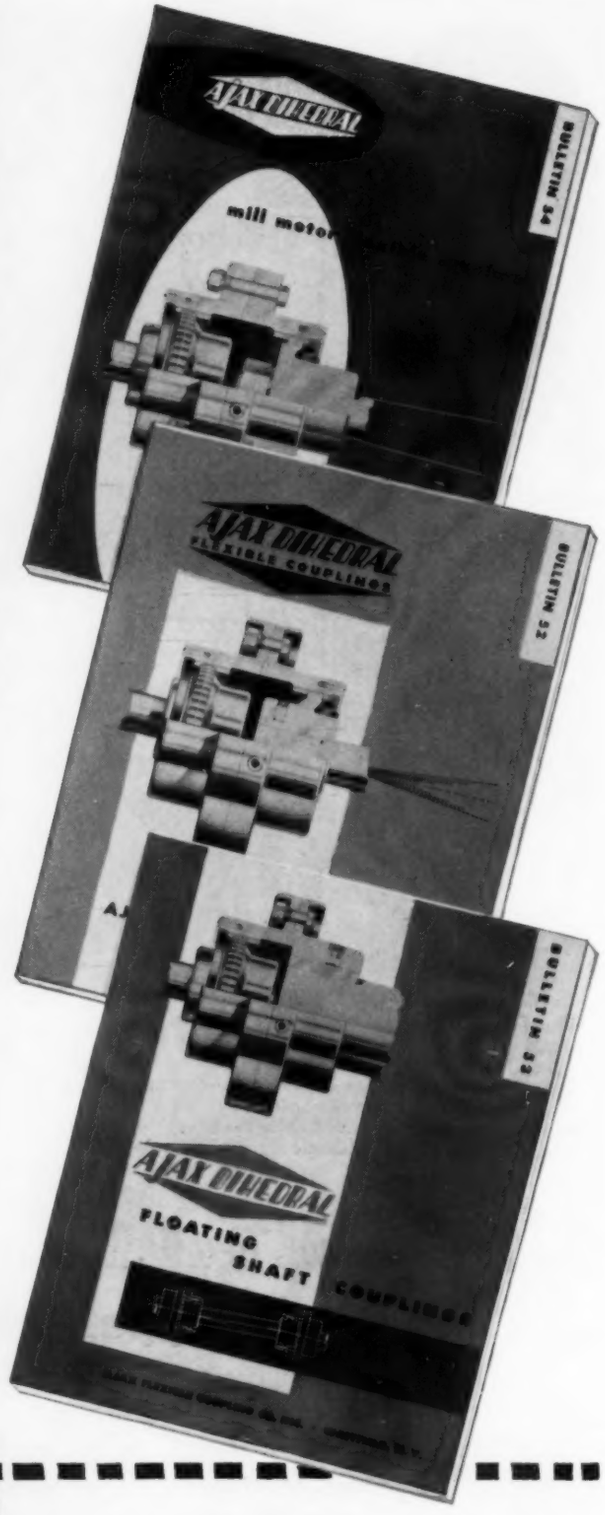
COUPLING BULLETINS

● Every man who is up against misalignment problems can get a lot of help from these Ajax Dihedral Coupling Bulletins.

They cover standard, floating shaft and mill motor type couplings.

They handle misalignment heretofore considered excessive. Standard dihedral teeth cut for 4° misalignment. Teeth to handle up to 12° misalignment cut to special order.

Tooth clearance (backlash) held to lubrication film requirements. All teeth hardened to 50-55 Rockwell C. Write or mail coupon for full information on America's finest flexible coupling.



AJAX FLEXIBLE COUPLING CO. INC.
Westfield, New York

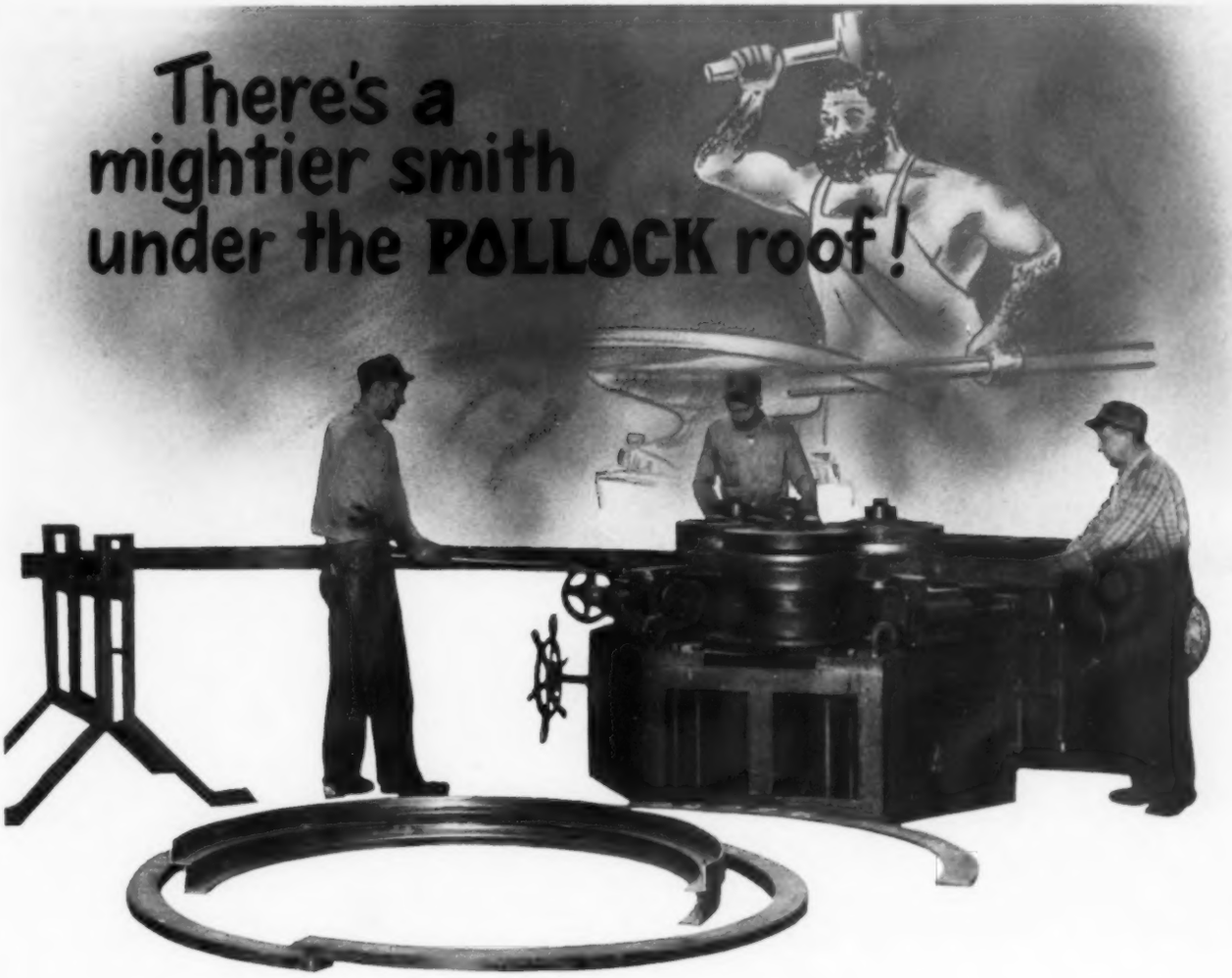
Please send bulletins on Ajax Dihedral Couplings addressed to my personal attention.

*Name*_____

*Concern*_____

*Street*_____

*City*_____ *State*_____



A mighty man was he . . . but even Longfellow's smithy couldn't forge the many tons of angles used in the construction of a modern blast furnace. At The William B. Pollock Company that job is done by the angle bending rolls you see above.

These rolls bend angles from 2″ x 2″ to 5″ x 5″, and bars from 1″ x 3″ to 2″ x 4″ on edge, and from 1″ x 3″ to 1¼″ x 4″ flat bending, quickly, accurately and economically.

Bent angles and bars are used in blast furnace construction as flanges for gas mains and miscellaneous piping, and as supports for brick, rings and shelves. Also as shield stiffeners on hot metal and cinder cars, brick retaining members on ladle tops, etc.

These bending rolls are another example of how The William B. Pollock Company develops and maintains the special modern facilities required to meet the demands of iron and steel manufacturers throughout the world . . . facilities that speed production and reduce over all costs on big jobs.

Pollock-built Blast Furnaces

Pollock-built Hot Metal Ladle Cars

Pollock-built Open Hearth Ladles

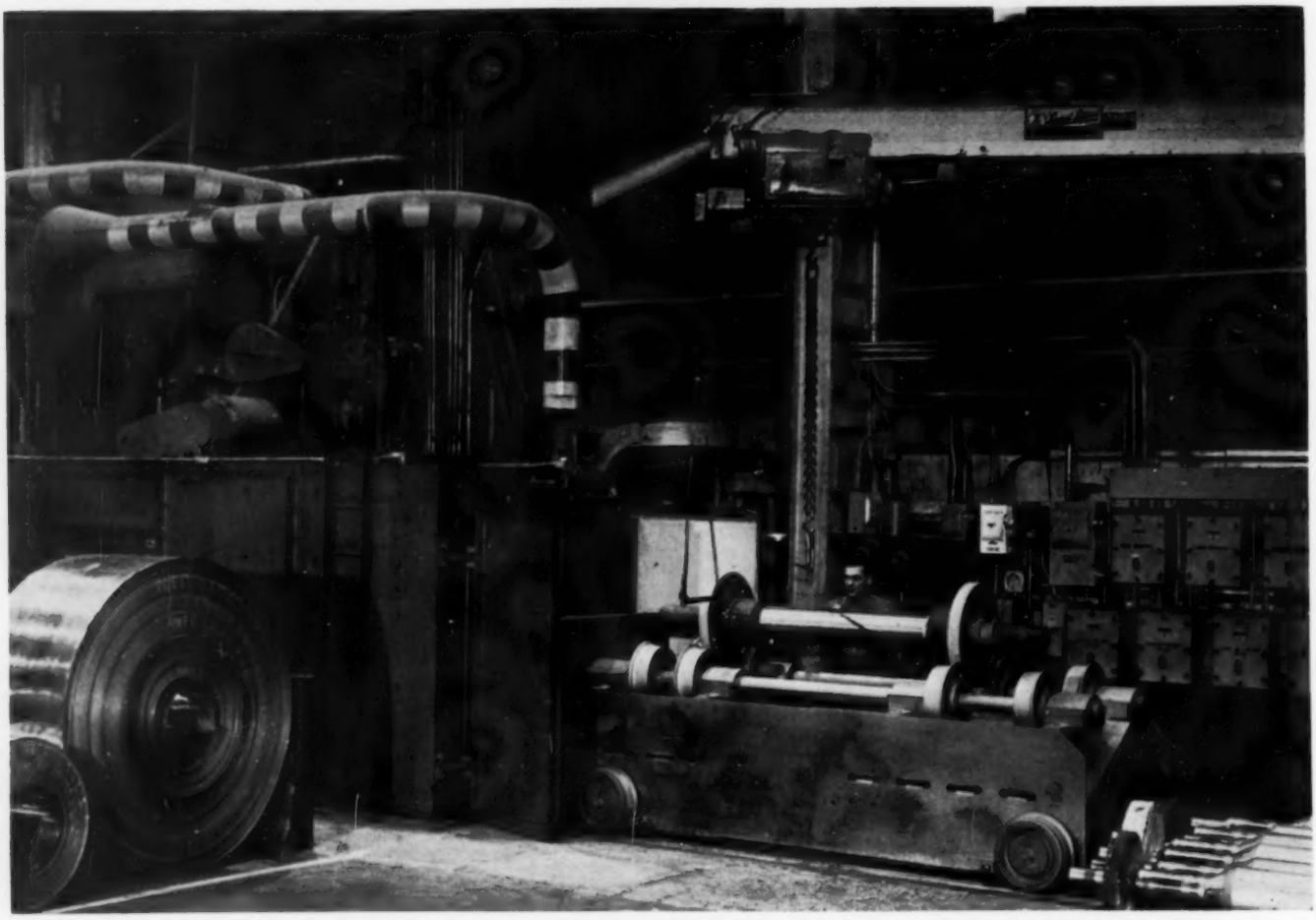
THE WILLIAM B. POLLOCK COMPANY

YOUNGSTOWN, OHIO

STEEL PLATE CONSTRUCTION • ENGINEERS • FABRICATORS • ERECTORS

BLAST FURNACES • HOT METAL CARS AND LADLES • CINDER AND SLAG CARS • INGOT MOULD CARS • CHARGING BOX CARS • WELDED OPEN HEARTH LADLES

pioneering developments keep **WHEELABRATOR**® *first in blast cleaning*



etching mill rolls in 3 minutes' blast time

Wheelabrator Airless Blasting opens new cost-savings possibilities

Large 26 and 27 inch diameter rolls, used in the cold mill, are etched in just 3 to 4 minutes' blast time at Weirton Steel Company. Temper mill rolls 8 to 9 inches in diameter are etched in 54 seconds' blast time. Using an Airless Wheelabrator etching machine, one operator can perform the complete cycle of loading, blasting and unloading in as little as 3 minutes' time.

PAYS FOR ITSELF — As a result of the more uniform etch obtained in just a few minutes' time, Wheelabrating opens new horizons in cost-saving possibilities. Weirton, for example, was able to amortize its entire investment quickly through savings in the cost of emery paper alone. Another major steel mill realized a 35% increase in the mill service of its Wheelabrator etched rolls.

AN IMPROVEMENT OVER AIRBLASTING — Wheelabrating produces a specified etch uniformly and automatically while airblasting requires several passes of the blast over the roll face under the observation of a skilled operator. Rolls etched with a Wheelabrator have a materially increased life in the mill with a resulting increase in tons rolled per set of rolls.

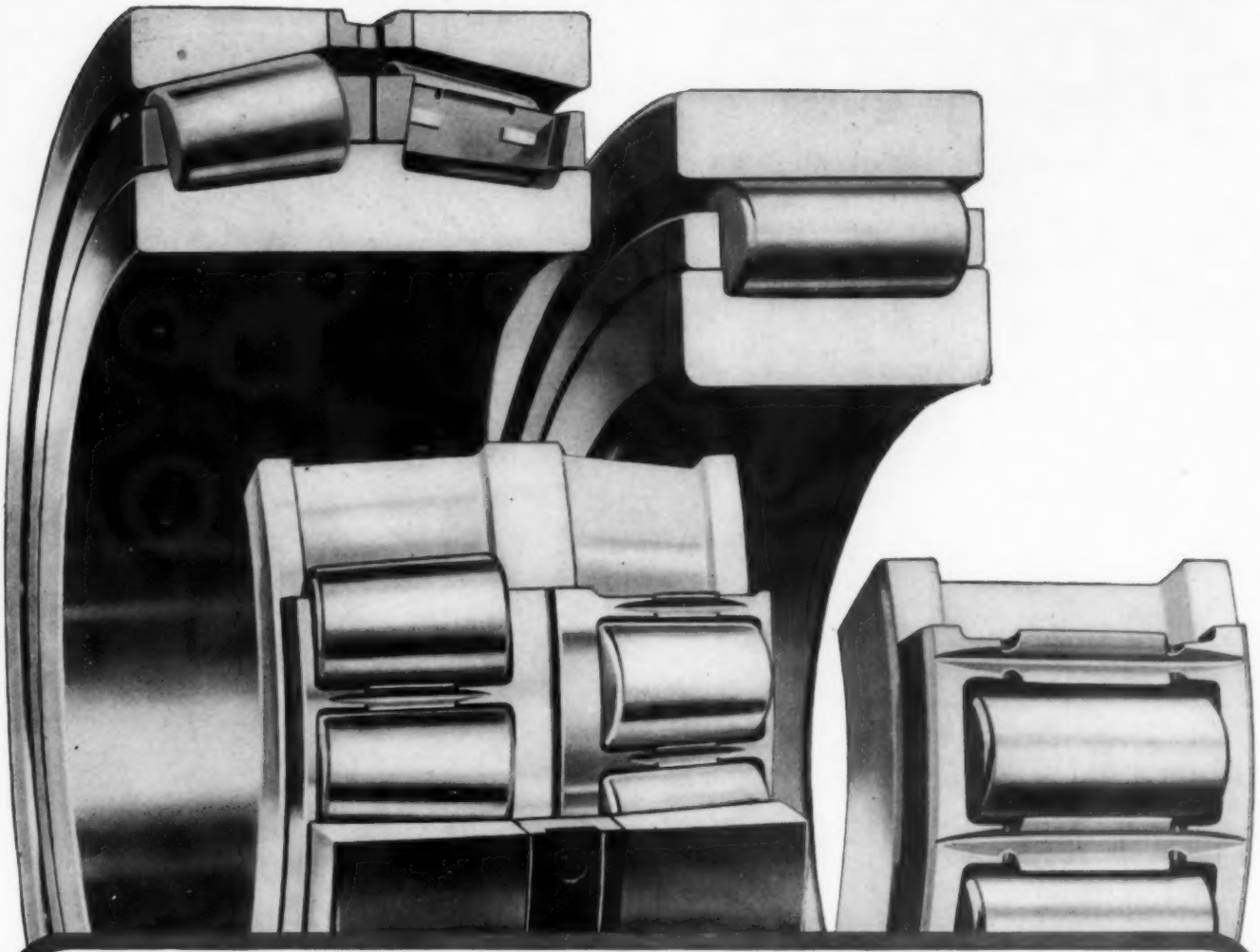
You, too, can save with the Wheelabrator. Write today for full details and a copy of Bulletin 884.

Wheelabrator Mechanical Cleaning is effecting unusual economies in the descaling and surface finishing of strip, sheet, bar stock, etc. Write for full details.

American
WHEELABRATOR & EQUIPMENT CORP.
396 S. Byrkit St., Mishawaka, Ind.

Wheelabrator®
AIRLESS BLAST CLEANING

WORLD'S LARGEST BUILDERS OF AIRLESS BLAST EQUIPMENT



TORRINGTON

TAPERED and CYLINDRICAL ROLLER BEARINGS

Give you these BIG ADVANTAGES

- **One-piece cast-bronze cages with machined pads in each roller pocket**—to assure accurate guiding of rollers.
- **Stabilized races**—to maintain accuracy of fit, improve bearing performance.
- **Individual roller retainment**—to assure adequate lubrication at roller, simplify inspection of race surfaces.
- **Precision tolerances and finishes on both rollers and races**—for minimum eccentricity and equal load distribution.
- **Controlled quality steels**—by use of electric furnace steels, through-hardening or case-hardening grades, and modern heat-treating methods—for increased bearing capacity and longer life.
- **Interchangeability**—in all types and sizes.

Backed by custom engineering to meet your load and speed requirements, these advantages add up to maximum performance for your bearing dollar. That's why it always pays to specify TORRINGTON!

THE TORRINGTON COMPANY
South Bend 21, Ind. • Torrington, Conn.

TORRINGTON BEARINGS

Spherical Roller • Tapered Roller • Cylindrical Roller • Needle • Ball • Needle Rollers

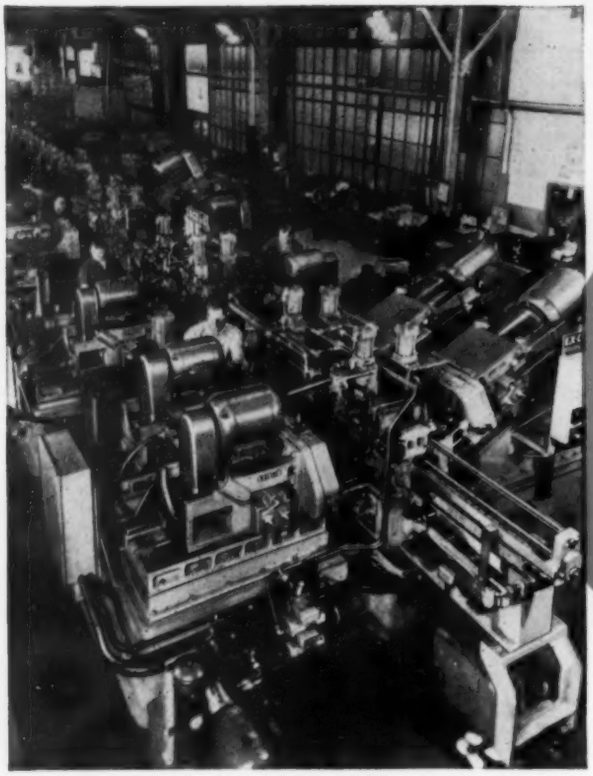


Photo Courtesy Ex-Cell-O Corp., Detroit, Mich.

Trabon

AUTOMATIC LUBRICATION
used on transfer machines
in large automotive plant

this has a BEARING on the subject

Illustrated here are transfer machines typical of several installed in the manufacturing plant of a large automotive producer . . . the first of which was put in operation during the early part of 1951.

Each of these machines is being automatically lubricated with a TRABON system. Two systems cover 195 bearing points each; two, 151 points each; and two, 305 points each.

Each system is so proportioned that slides, ways and heavily loaded working bearings receive the proper amount of lubricant every 20 to 30 minutes. All minor bearings on fixtures receive the exact amount of lubricant required every four hours.

Whether your problem is to lubricate a hot metal crane, crushers, ore unloaders, presses, rolling mills, blast furnaces, boring mills, or any other industrial application . . . a TRABON system is your answer.

Completely sealed—positive—hydraulic—handles oil or grease—backed by years of experience.

WRITE FOR BULLETIN 529

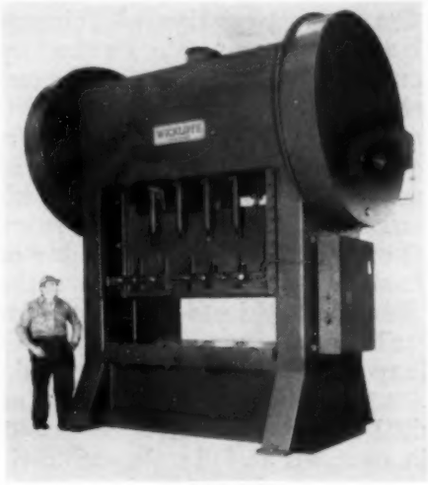
Trabon **ENGINEERING CORPORATION**
1814 E. 40th STREET • CLEVELAND 3, OHIO
Oil and Grease Systems

Equipment News...

HEAVY PRESSES

▲Cleveland Crane & Engineering Co. announced their entry into the heavy press field with the introduction of a completely new line of presses ranging from 160 tons capacity and up.

The new machines, to be known as "Wickliffe" presses, will supplement the "Steelweld" bending press and shear lines which were originally developed and introduced by the company many years ago and are now in extensive use. They are intended for uses such as forming, blanking, piercing, trimming, light embossing and drawing.



Under development for over three years by some of the foremost engineers in the press field, the new presses, which are mechanically operated, include the latest features production men require for high-speed mass-production runs. They are generously designed throughout to provide great rigidity, long life and minimize maintenance. All parts are readily accessible and, should occasion demand, very easily removed and replaced.

Frames are straight-sided and consist of four members — crown, two side housings and bed—held solidly together by tie rods shrunk in place. All members are "box-type" and of heavy all-welded steel construction.

Slide adjustment is of the modern barrel-type. It provides extra stability, especially desirable on long adjustments. The entire adjusting unit is compact, self-contained and very easily removed from or assembled to the slide.

The clutch and brake, often called the heart of a press, are outstanding on these new presses. Especially developed for heavy press service, they operate unusually smoothly for long periods of time without need of frequent adjustment. Having been fully proven on many "Steelweld" machines under various conditions, their design was readily adapted for the new machines.

Operated by air, the clutch and brake are designed with an ingenious low-inertia principle. Cool operation is assured, even after long periods of continuous production runs because of four contributing factors:

1. Low unit working pressure on clutch and brake facings.
2. Low inertia of clutch and brake discs which minimize energy to be absorbed.
3. Hollow center ventilating discs which have large cooling passages.
4. Overall design for fast heat dissipation.

Worn linings are easily replaced without removing clutch or brake from the machine. However, because they are of the rivetless type extra long wear is provided between lining changes.

Particular attention has been given to ease of operation and safety. By means of push buttons, the operator has full control of the press during any part of the stroke. Adjustment of the slide is also push-button controlled. All rotating parts are well removed from the operator's normal reach and all gearing is fully enclosed.

Complete lines of single, two and four point, single-action presses have been developed. Special care has been taken to provide for the greatest possible duplication of parts between the models, thus minimizing spare parts inventories for large press users.

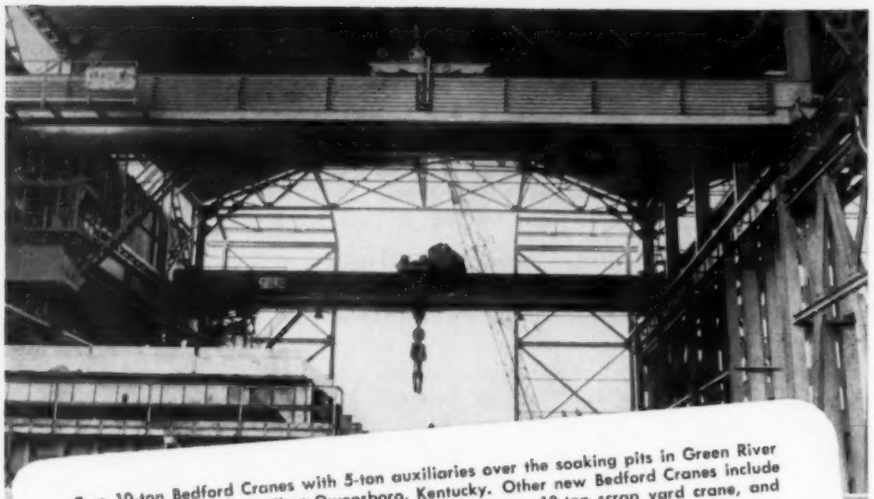
ROLL GAGES

▲The control of quality by precise gaging at the rolling mill is inadequate if the accuracy of the rolls is not controlled. It is therefore necessary that quality control begin with the grinding of the rolls. That's how Wallingford Steel Co. wanted it when they called upon Pratt & Whitney gage specialists. They needed gages of extreme accuracy for both their roll grinding and their rolling operations. Roll grinding had to be held to a very close tolerance on diameter as well as contour and some of the rolling was held to a few micro-inches. Not only that, but they wanted a permanent record of the rolls ground showing the contour in a highly magnified condition.

Pratt & Whitney, division Niles-Bement-Pond Co., applied four gages to this problem. Two "Electrolimit" gages: the roll grinder contour gage and the model "C" snap gage were adapted to the roll grinding machine; while an "Electrolimit" model "D" flying mike and a beta ray gage were set up for the actual rolling operation.

The roll grinder contour gage is a special application of the "Electrolimit" height gage, and in this instance has been used together with a special Bristol recorder and selsyn chart drive. The unit is adapted to roll grinders for measuring and drawing on a chart the exact contour of the roll in a highly magnified condition. The selsyn chart drive on the recorder is driven such that 1 in. of table, or wheel, travel is equal to 1 in. of chart travel. By this method the graph of the roll contour is the same length as the roll being inspected and quick accurate comparisons can be made. The power unit for this gage is

The beta ray gage, one of four specially designed for Wallingford Steel Co., measures thickness variations of strip down to .002 in. A radiation beam measures a fixed section of strip—the gage being calibrated to show per cent deviation from weight per unit area.



Two 10-ton Bedford Cranes with 5-ton auxiliaries over the soaking pits in Green River Steel Company's new mill at Owensboro, Kentucky. Other new Bedford Cranes include one 75-ton ladle crane, one 25-ton charging crane, one 10-ton scrap yard crane, and two 10-ton utility cranes.

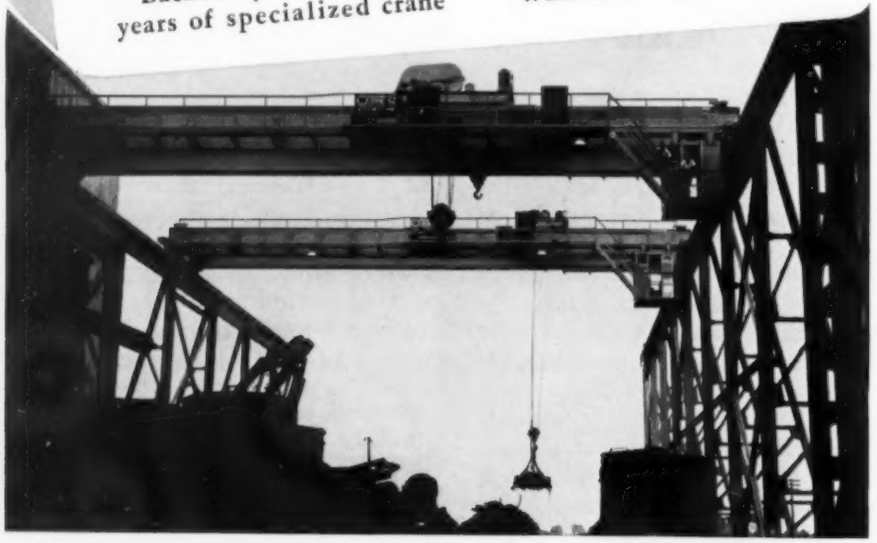
Seven New Bedfords at Green River Steel

More and more steel men are comparing—and choosing Bedford Cranes for advanced design—for precision engineering—for safe, smooth, dependable performance.

Backed by more than 50 years of specialized crane building experience—each Bedford Crane is custom engineered for its specific application.

Available in all types and sizes from 5 tons to 350 tons—and up!

Write for complete catalog.



Foreground: 25-ton Bedford charging crane with 5-ton auxiliary.
Background: 10-ton Bedford scrap yard crane.

BEDFORD CRANES — SERVICE

STEEL MILL CRANES

BEDFORD

BEDFORD FOUNDRY & MACHINE COMPANY, INC. - BEDFORD, INDIANA

set up for dual magnification with chart graduations being either .0001 or .00005 in., depending on the magnification used.

There are many outstanding advantages in the electrolimit design. The small, compact gage head is easily used by the operator while the indicating meter or recorder may be set up some distance away—at his convenience. The circuit has excellent stability and repeatability. In addition to providing a permanent record, the roll contour gage provides a means of aligning and setting up the grinder, shows the taper in a roll, and is a means of inspecting a roll after it is removed from the mill permitting further study in regard to roll design, shape, etc. It can also be used to check runout.

The contour gage is not intended to be used for a working gage or to measure diameter. For these applications the snap gage is used. This gage is a portable comparator for checking outside dimensions right on the machine or in the inspection department. It consists of two units, the gage body with the frame and the portable instrument cabinet which houses the electrical units. There are three gage bodies and a number of frames for each body which cover the size range of ½ in. to 10 in. In this installation the snap gage was used to keep the rolls being ground, within .00005 in. tolerance. The gage has dual magnification of either ±.001 in. or ±.002 in. full scale, each division representing .00005 in. or .0001 in.

After finish grinding and inspecting the ground rolls with the contour and the snap gages, the rolls are used in the rolling operations of a Sendzimir cold strip rolling mill. In this application the other two gages, both continuous, are used.

The "Electrolimit Model D," combining the "Electrolimit" principle of precision mechanical gaging with electrical magnification is of the contact type. Variations in thickness to .0001 in. are continuously and accurately indicated. There is no need to even slow down the production process. The model "D" continuous gage consists of three parts: the gage head, the power unit, and the indicating meter. The indicating meter in this case is mounted in the control cabinet. There is also an optional strip recorder in the control panel that

HAGAN Air-operated Controls and Ring Balance Instruments

for *reliable* operation of
soaking pits • coke ovens • blast furnaces
reheating furnaces • gas distribution systems
open hearth furnaces • steam boilers

- Heat Input Control
- Fuel-Air Ratio Control
- Furnace Pressure Control
- Gas Pressure Control
- Furnace Reversal Control
- Multiple Fuel Firing Control
- Gas Mixing Station Control
- Blast Furnace Blower Control
- Draft and Pressure Recorders
- Flow Meters for Gases and Liquids
- BTU Meters for Mixed Fuels
- Automatic Pressure and Temperature Compensation for Flow Meters

Steel making involves complex metering and control problems. In all phases of steel production, Hagan Ring Balance Instruments and Air-Operated Controls solve these problems smoothly and efficiently. Hagan equipment combines the utmost in reliability and accuracy with a minimum of maintenance and operating expense, because it is simply designed and sturdily built.

Experienced Hagan engineers are ready to help you solve your metering and control problems. For information, write, wire or phone . . .

HAGAN CORPORATION

HAGAN BUILDING, PITTSBURGH 30, PENNSYLVANIA

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
CONTROL SYSTEMS FOR AERONAUTICAL
AND AUTOMOTIVE TESTING FACILITIES

You get all 4
— Safety
— Economy
— Dependability
— Long Life

with TAYLOR MADE
the only complete line of
ALLOY STEEL CHAIN
because...

● Taylor Made Alloy Steel Chain has twice the tensile strength (125,000 lbs. P.S.I.) of wrought iron chain (48,000 lbs. P.S.I.)!

● This famous nationally advertised chain is heat-treated—never requires annealing!

● It has tremendous resistance to shock, grain-growth and work-hardness at all temperatures!

● All slings are furnished with amazing new Taylor Made Alloy Steel Tayco Hooks!

● Rings, joiner links and other sling attachments are of the same analysis, heat-treated alloy steel as the chain.

S. G. TAYLOR CHAIN CO., Hammond, Ind.

Send coupon for free folder

S. G. Taylor Chain Co.
Dept. 5, Hammond, Indiana
Rush free copy of Booklet No. 12C giving all the facts and specifications on Taylor Made Alloy Steel Chain!

Name_____

Address_____

TAYLOR MADE
A GREAT NAME IN
Chain SINCE 1873

may be used. Mounting is by a transverse slide carrying both gages, allowing either to be moved onto the work. Gaging is accomplished with the Model "D" by passing the material between two small gaging rolls. The gage is easily pre-set to .0001 in. for any desired thickness by a visible indicator on the gage head.

The second of the two gages is the beta ray gage. This gage is of the non-contacting type. It is extremely accurate and will detect thickness variations of a few micro-inches in steel. The beta ray continuous gage consists of a gaging head, the power unit, a setter and the mounting. The beta ray gage used on this mill utilizes the same mounting as the Model "D" gage. The gaging unit, the power unit and the setter are sealed against moisture, dust and dirt.

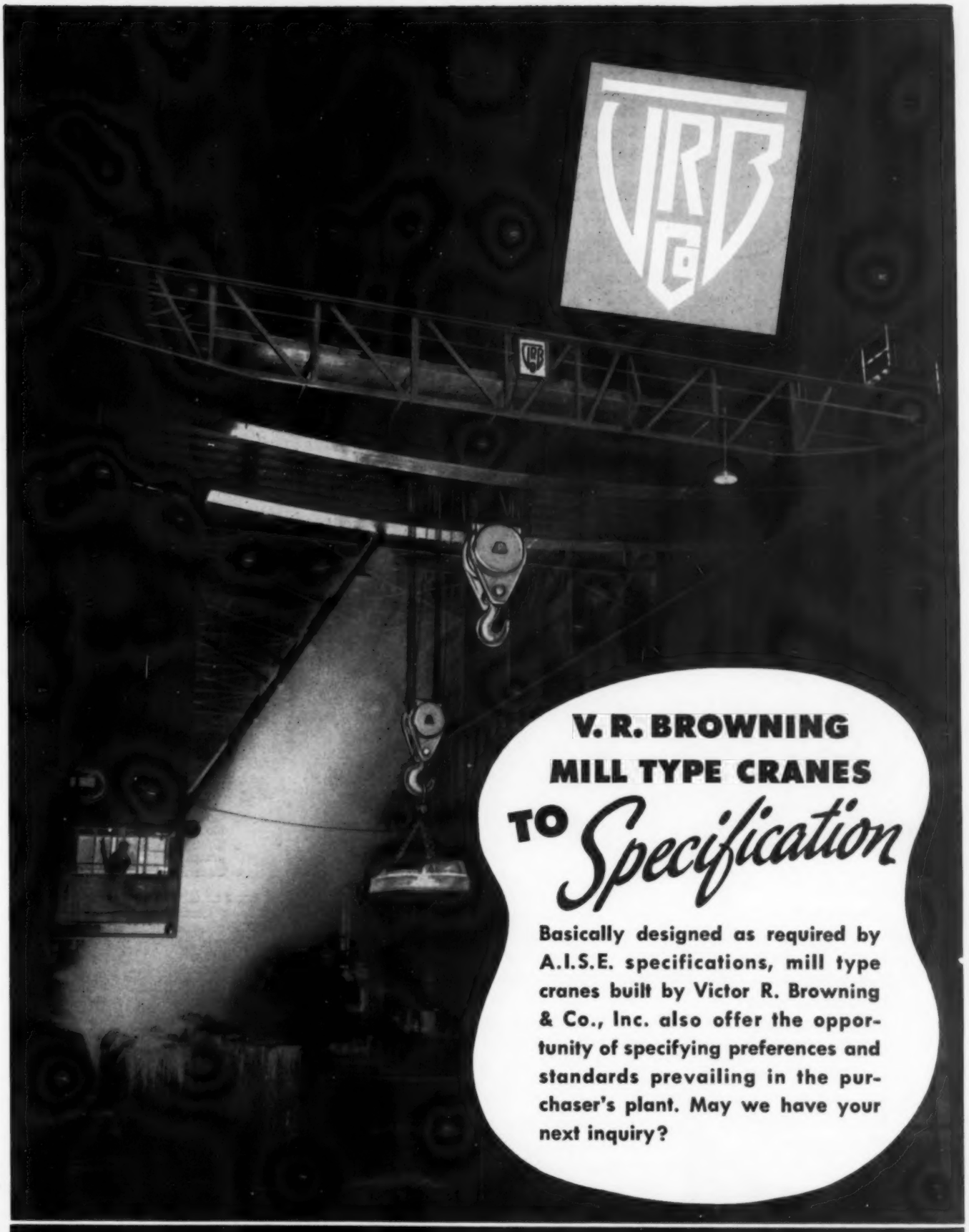
This gage is essentially a weighing device, which weighs a fixed area of the moving strip by means of a small beam of radiation. The beta ray gage is normally calibrated to read in per cent deviation from weight per unit area. "Strontium 90" in solid form having a half life of 25 years is the radio active source.

At Wallingford Steel both the Model "D" continuous gage and the beta ray gage are wired to the same meter in the control panel. The thickness of the steel being rolled is the deciding factor in determining which gage will be used. The Model "D" gages are used from .125 in. down to .015 in., while the beta ray gage is used from .015 in. down to .002 in. Both the Model "D" and the beta ray gages are mounted on cross slides, a pair at each end of the mill, and either can be used depending on the thickness of the strip being rolled.

Thus, the use of effective gaging at the roll grinder insures better quality of strip coming off the mill; furthermore, the permanent record left by the contour gage is proof that the rolls ground are correct when put into the mill. Use of this system has enabled Wallingford Steel to hold tolerances to .0001 in. or better on the Sendzimir cold strip rolling mill.

POLYPHASE A-C MOTOR

▲A new line of polyphase a-c motors, offering better protection, more efficiency, and quieter operation has been announced by the General Electric Co.'s small integral and medium induction motor departments.

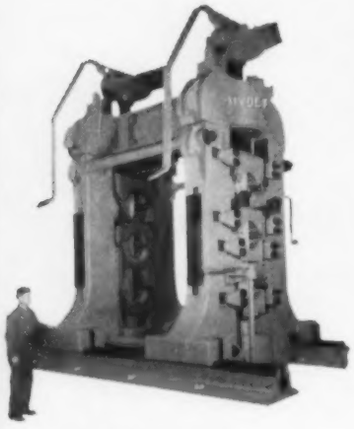

V. R. BROWNING
MILL TYPE CRANES
TO Specification
Basically designed as required by A.I.S.E. specifications, mill type cranes built by Victor R. Browning & Co., Inc. also offer the opportunity of specifying preferences and standards prevailing in the purchaser's plant. May we have your next inquiry?
VICTOR R. BROWNING & COMPANY, Inc.
BOX 309, WILLOUGHBY (CLEVELAND), OHIO
Designers and Builders of Electric Overhead Traveling Cranes and Hoists and Electric Revolving Cranes

Hyde Park

RED CIRCLE Rolls ALLOY-CHILLED

Rolling Mill Equipment

Outstanding in quality and in performance Hyde Park Rolling Mill Equipment has enjoyed the respect of the industry for more than fifty years.



Bar Mills
Merchant Mills
Sheet and Strip Mills
Pinion Stands
Roller Tables
Reduction Drives
Stretcher Levellers
Guillotine Shears
Sheet Mill Shears
Roll Lathes
Special Machinery
Machine Work

Hyde Park

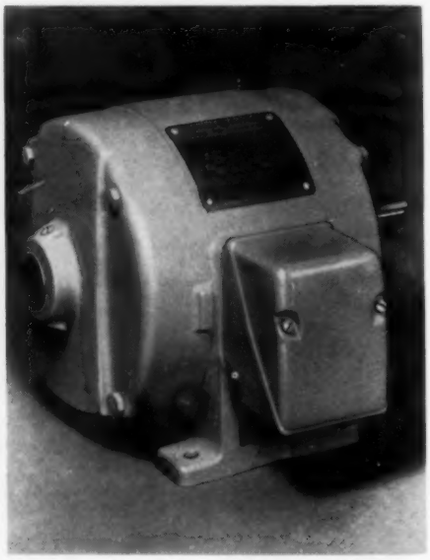
FOUNDRY & MACHINE CO.
Hyde Park, Westmoreland County, Pa.

ROLLS
ROLLING MILL MACHINERY
GREY IRON CASTINGS

Called "Tri-Clad 55," the new motors are the result of more than 250,000 man-hours of developmental engineering and research. Built to latest standard NEMA frame dimensions, they feature entirely new and advanced concepts of motor design.

With an average size reduction of 50 per cent by volume and averaging 22 per cent less weight per horsepower, the "55" retains rigid cast-iron construction and incorporates a new insulation system, bearing assembly, and ventilation plan, according to G-E engineers.

The keystone of the insulation system is a new polyester film which is eight times as strong as previously used materials. It is used to insulate the phases and slot tubes in the stator —the points of hardest motor wear.

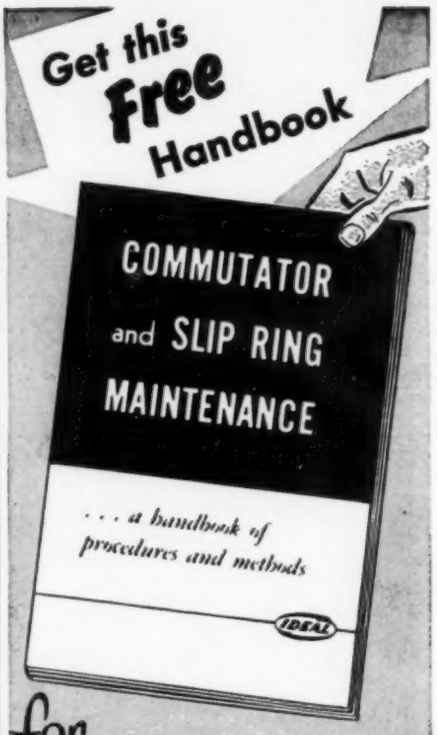


This synthetic material, combined with Formex wire, an improved Glyptal varnish, and a silicon Dri-film dip, has withstood accelerated life tests and salt-spray tests better than any other system tried, the engineers said.

The new bearing assembly is more tightly sealed and is lubricated by a grease which lasts at least five times longer than formerly used lubricants. A double-end ventilation system uniformly cools the motor by drawing air in from beneath both endshields, through carefully baffled air passages, and out louvers on the sides of the frame. Larger integrally-cast rotor fans increase the cooling air flow through the motor and dissipate rotor heat more effectively. Protection has been increased by 60 per cent on the drip-proof enclosure through new end-shield and frame design.

(*Please turn to page 208*)

Get this Free Handbook



for MAINTENANCE MEN
INSTRUCTORS
and TRAINEES
in Motor Maintenance

THE methods and procedures described were developed by recognized, practicing maintenance authorities. They have been proven by conclusive evidence over many years in hundreds of operations. A concise guide, this 39-page handbook tells the practical operating man everything he needs to know about:

- Commutator and slip ring troubles and how to correct them.
- Brush maintenance and operating procedure.
- General maintenance procedure.

Dozens of illustrations show the operations described. Condensed data on IDEAL commutator and slip ring products is included.
Even if you do not have a regular maintenance training program, your people responsible for motor and generator maintenance need, and will do a better job, with the help of this handbook.

NOTE: This offer is limited to those in plant and other industrial operations. We reserve right to limit quantities furnished. Offer may be withdrawn at any time.

IDEAL INDUSTRIES, Inc. IDEAL
1045 Park Avenue, Sycamore, Illinois

Please send _____ copies of your free handbook on commutator and slip ring maintenance.

Name_____
Title_____
Company_____
Address_____
City_____ Zone___ State_____

8 cell cooling tower driven by 8 Wagner Multi-speed Motors.

Here's a job for *Rugged* motors

This 8 cell Marley Cooling Tower, at Pueblo, Colorado, provides a steady supply of 6600 gallons of cooling water per minute for a steam power plant. There are 8 fans with blades 22 feet in diameter that are driven, through gear reducers, by 8 Wagner two-speed, totally-enclosed fan-cooled motors. These 440 volt motors are each rated 75/19 hp.

Cooling towers need motors with plenty of stamina. They must operate without attention, day in and day out, completely exposed to all kinds of weather.

Wagner totally-enclosed fan-cooled motors are built to operate under severe conditions. They are available in steel or cast iron frames, in standard or explosion-proof types, single-speed or multi-speed, single phase, 2 phase or 3 phase, in ratings to 250 hp.

For your requirements, there is a Wagner Motor to fit every need—a complete line for all current specifications, with a wide variety of enclosure types and mountings. Bulletin MU-185 gives full information. Do you have a copy?

Your nearby Wagner engineer will be glad to help you select the *right* motors for your next application. Call the nearest of our 32 branch offices, or write us.

®Wagner Electric Corporation
EST. WE 1891

WAGNER ELECTRIC CORPORATION
6483 Plymouth Ave., St. Louis 14, Mo., U.S.A.

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS – AIR AND HYDRAULIC

BRANCHES IN 32 PRINCIPAL CITIES

M53-18

It pays to buy USG® BRUSHES

For crane motors — mill motors — tin line generators — for all rotating electrical equipment — USG BRUSHES are best.

Our brush engineers can analyze and solve those tough application problems. Give our experienced representatives a chance to prove it with a performance test.

WRITE US TODAY
ASK FOR OUR CATALOG

178

THE UNITED STATES GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION • SAGINAW, MICHIGAN

Industrial Cut Gears

FOR ACCURATE TRANSMISSION OF *POWER*

Whether the machinery or equipment is arranged for continuous or intermittent operation—the gearing must transmit the predetermined load without compromise.

"Industrial Cut Gears" can be depended upon to deliver full calculated power wherever installed . . . on machine tools, steel mill equipment, tractors, road machinery, shovels, cranes, farm machines, trucks, etc.

If you are not already using "I-G" or "I-G Durocase" Gears, specify them for all general or heavy-duty steel mill service. You will obtain results that are outstanding.

Send us your specifications for a prompt quotation on your requirements. Also write for Brochure "A Pictorial Trip Through Industrial Gear."

MEMBER OF AGMA

Industrial Gear Mfg. Co.

4527 W. VAN BUREN ST.
CHICAGO 24, ILLINOIS

Newest Safety

Bailey ENGINEERS

heavy duty
GOGGLE VALVES
THERMAL EXPANSION TYPE

Now produced in a new heavy duty model, these valves operate by linear expansion and contraction of three sets of tubes spaced around the rigid steel flange. Steam passed into the tubes causes them to expand, thus separating the flanges and freeing the goggle plate. When steam is removed, contraction closes the flanges against the goggle plate. Available in diameters of 36" to 120".

WILLIAM M. Bailey COMPANY
ENGINEERS
LEADERSHIP THROUGH QUALITY
1221 BANKSVILLE ROAD PITTSBURGH 16, PA.

(*Continued from page 204*)

A major part of the new motor design involves noise levels. In a specially-constructed laboratory, G-E engineers sought the causes of motor noise and found a way to reduce overall sound levels and alter the motor sound to a frequency more pleasing to the human ear. According to the engineers, the noise level of the new 10-hp motor tests as low as the former 2-hp model. All new Tri-Clad motors must now pass a quality control sound test before leaving the factory.

The totally-enclosed fan-cooled motor also has been redesigned. Electrical parts are completely enclosed by tightly sealed cast-iron frame and end shields, a compression-fit lead seal, and a rotating labyrinth seal on the shaft. A new "jet" ventilation system blankets the frame with cooling air. Plastic fan, stainless steel nameplate, and other exposed parts are corrosion-resistant.

Besides the longer-life lubricating grease, other improved maintenance features include permanently-numbered, non-wicking connection leads, a larger diagonally-split conduit box, knockoff lugs on the end shields, and location of the combination nameplate-connection diagram directly over the box.

Although size and weight have been materially reduced and new design concepts incorporated, the new Tri-Clad "55" has high efficiency and will operate under greater full-load speed conditions than the former motor, the engineers said.

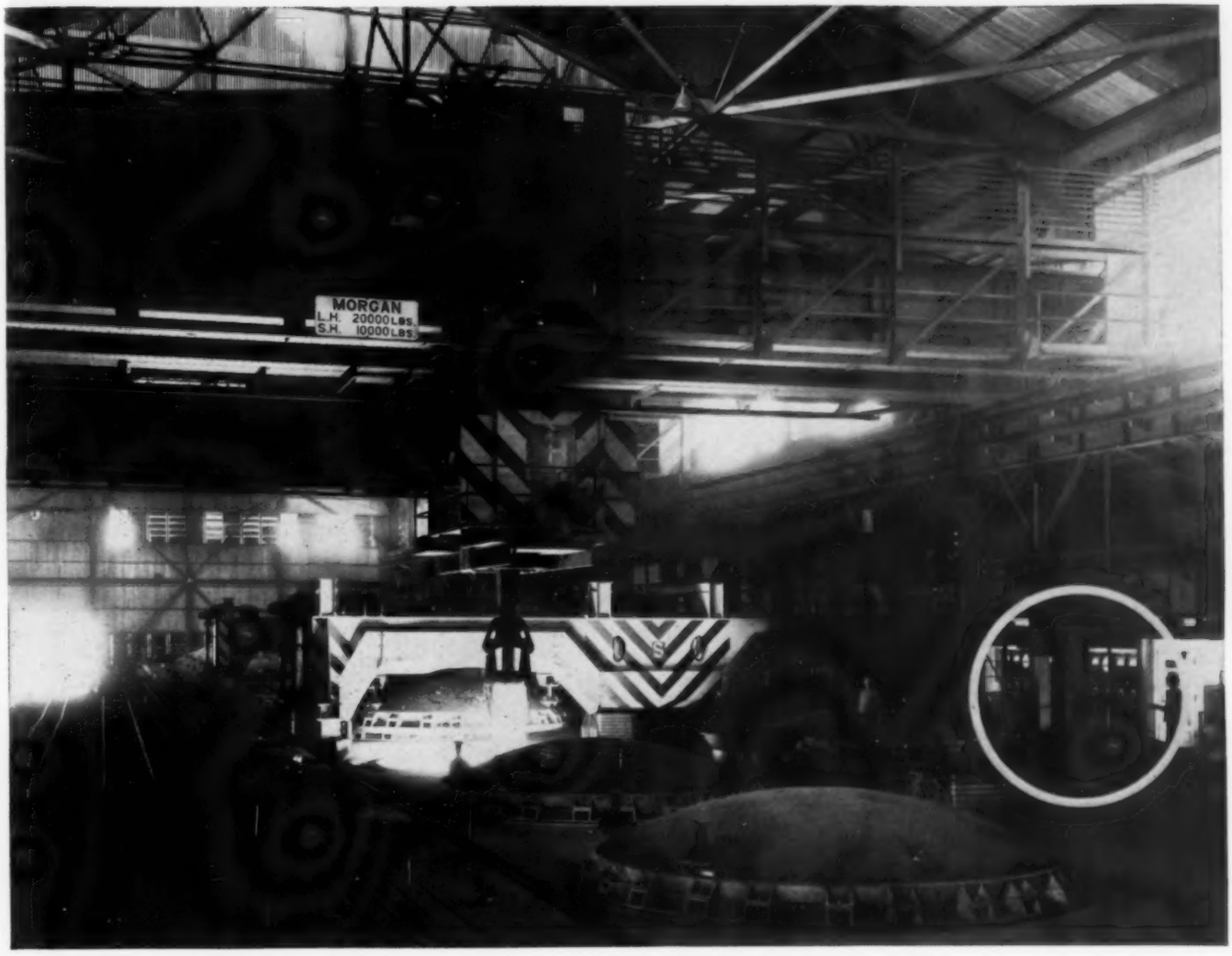
After the first of the year, the new motors will be available in the 182 and 184 frame sizes (1, 1½, and 2-hp at 1800 rpm) in horizontal drip-proof and totally-enclosed fan-cooled models, and a complete line of gear-motors. Larger frame sizes will become available at regular intervals.

Other types planned for production during 1954 include vertical, single-phase, wound rotor, explosion-proof, multi-speed, face-mounted and flange-mounted models.

ALLOY ELECTRODE

▲A new electrode particularly suited for hard-facing mining, crushing and other types of heavy equipment has just been introduced by the Stoody Co. Performance records of this alloy —coated tube "Stoodite"—compare with most electrodes selling at a

(*Please turn to page 213*)



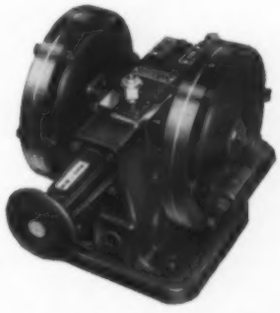
ASKANIA SOAKING PIT CONTROLS at C.F. & I., Pueblo

The Askania control panel spotlighted in the circle above is one of six for this 24-pit installation at the Pueblo Works of the Colorado Fuel & Iron Corporation. Just as on hundreds of other soaking pits across the country, these controls are doing the Askania job—helping to make more steel and better steel for less money.

Simple and Complete—This is a typical straightforward Askania control system. It includes fuel-air ratio and pit pressure controls, to help the operator get the same good results in heat after heat. Hydraulic operation and the Askania Jet Pipe principle mean long life and easy maintenance.

Fuel-Air Ratio Control—Most critical in soaking pit control is fuel-air ratio control. For good scale formation and fuel economy, fuel and air must be accurately proportioned over a wide range of fuel flows. In Askania control the forces that represent fuel flow and air flow are directly balanced against each other through a simple lever system. This permits easy change of ratio setting and assures precise proportioning over turndowns of 10 to 1, where the actual signal turndown is 100 to 1.

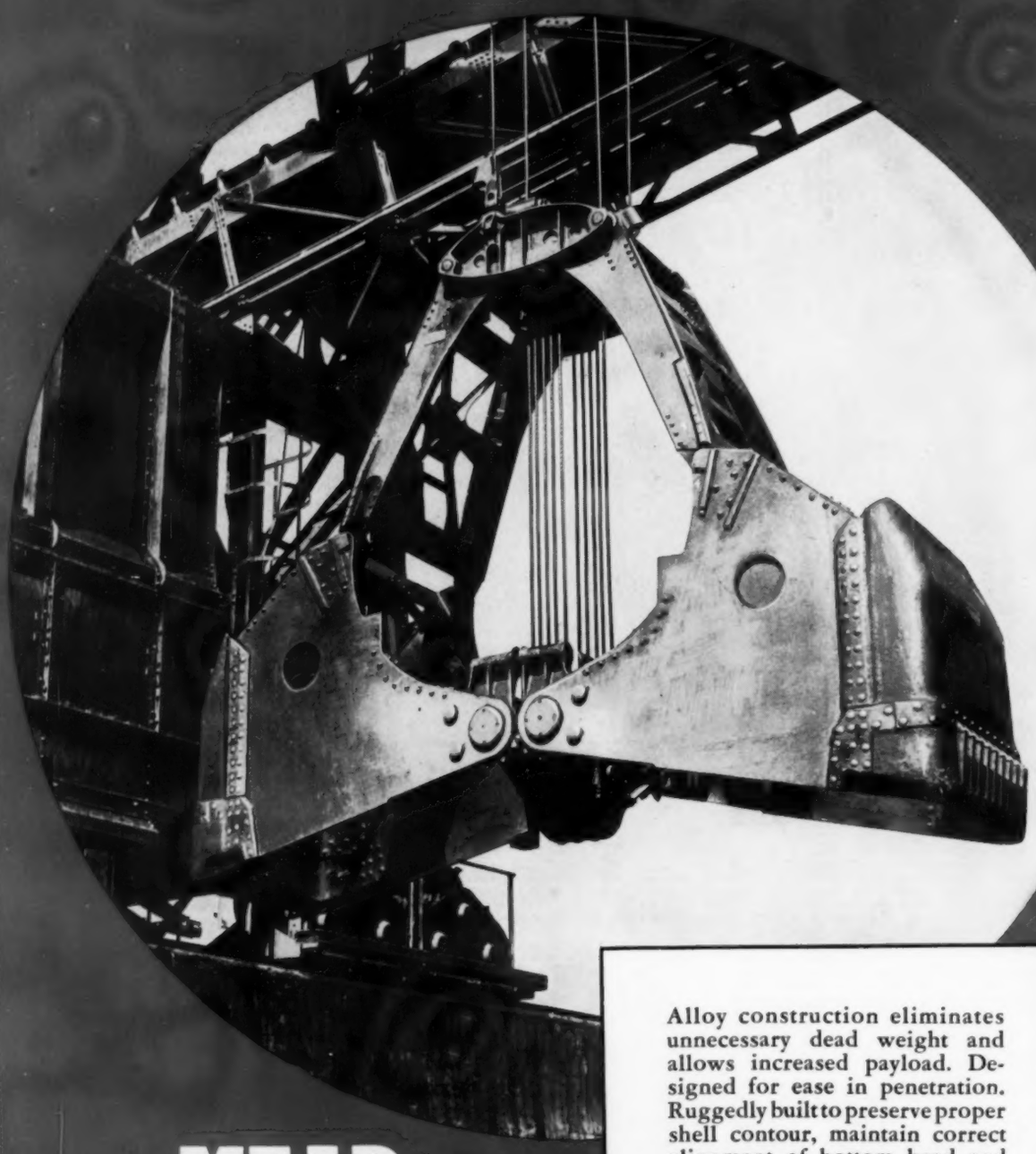
Write for Bulletin 116, Askania Controls for Soaking Pits.



Askania Fuel-Air Ratio Regulator. Simple design means accuracy over wide turndowns.

ASKANIA REGULATOR COMPANY
246 E. Ontario Street, Chicago, Illinois
Subsidiary of General Precision Equipment Corp.

MEAD-MORRISON Ore Buckets



Alloy construction eliminates unnecessary dead weight and allows increased payload. Designed for ease in penetration. Ruggedly built to preserve proper shell contour, maintain correct alignment of bottom head and shell and withstand operating abuse.

Designs to operate at ends of lines and bight of line in a range of sizes. Also clean-up grabs.

Write for full information.

MEAD-MORRISON

Division of

McKIERNAN-TERRY CORPORATION

Manufacturing Engineers • Harrison, N. J.

Also builders of coal and ore bridges, bulk material unloaders, pile hammers, and specially designed machinery

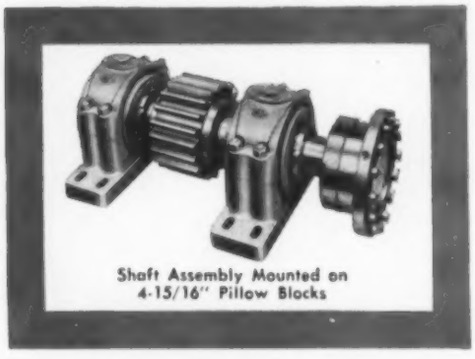
When It Comes to POWER TRANSMISSION On the BIG JOBS

Look to... Jones

Cement Kiln Drive

JONES Products—*While specifically* designed for the heavy industries — *are competitive for all applications.* All the added values of sturdier design, heavier construction and better materials are yours without extra cost.

Ask for Bulletins



Shaft Assembly Mounted on 4-15/16" Pillow Blocks

SPEED REDUCERS AND COMPLETE DRIVES TO 500 HORSEPOWER

HERRINGBONE WORM GEAR WORM HELICAL

PILLOW BLOCKS to 9" Shaft Size

Timken Equipped, Adaptor Sleeve Type
Self-Aligning, Dust-Tight
Sizes to 4-15/16" in Stock

Jones 60" x 57" Rubber Covered Pulley mounted on 9" Jones Timken Pillow Blocks

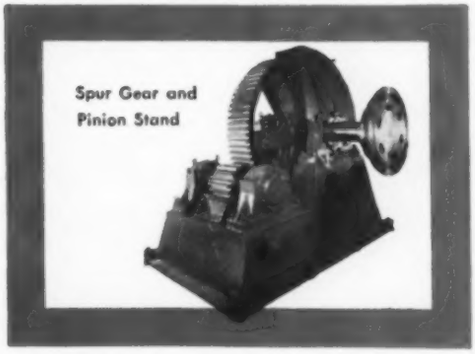
CAST IRON CONVEYOR PULLEYS

Tailor-Made to Your Requirements.

CUT GEARS

to Your Specifications

HERRINGBONE - WORM
HELICAL - BEVEL - SPUR



Spur Gear and Pinion Stand

W. A. JONES FOUNDRY & MACHINE CO., 4431 W. Roosevelt Rd., Chicago 24, Ill.

Since 1890

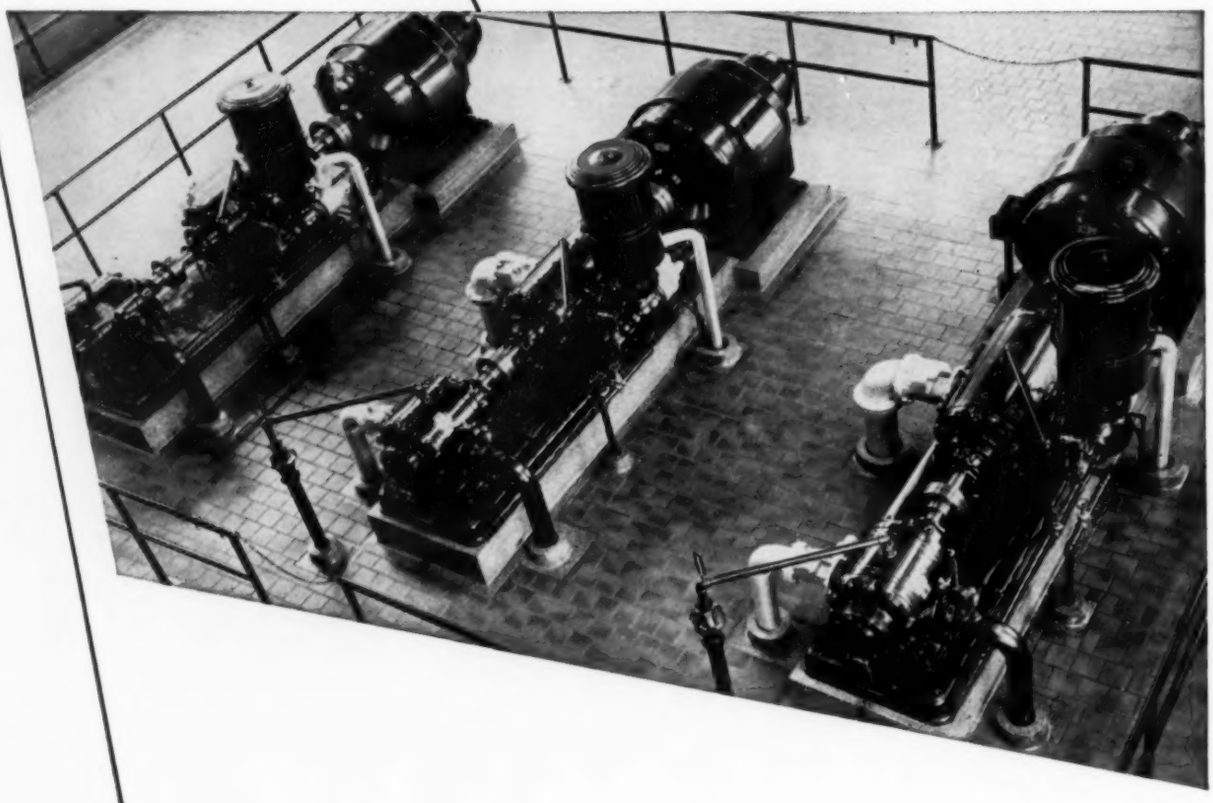
Jones

In The Service Of Industry

HERRINGBONE — WORM — SPUR — GEAR SPEED REDUCERS
CAST IRON PULLEYS • CUT GEARS • V-BELT SHEAVES
ANTI-FRICTION PILLOW BLOCKS • FLEXIBLE COUPLINGS

YOU ELIMINATE
HEAVY FOUNDATION COSTS
WHEN YOU INSTALL

Fuller Rotary Compressors



You eliminate heavy concrete foundations when you install Fuller Rotaries . . . even with the larger capacity machines . . . because with rotary there is no vibration. The battery of three Fullers shown above, having a capacity of 1085 c.f.m. each, at 100-lb. pressure, are mounted on comparatively light terrazzo foundations . . . and they're on an upper floor of the building. The installation is compact, streamlined, and efficient in operation.

Not only do you save in foundation costs, but Fullers have many other inherent advantages. They're simple in design, are easily operated, ruggedly built. And, they give you a *maintained capacity for the life of the machine.* They've *earned* their reputation for complete dependability.

Bulletin C-6 illustrates and describes these quality compressors . . . send for your copy today, and see how they will fit into your own plans and operations.

FULLER COMPANY, Catasauqua, Pa.
120 So. LaSalle St. • Chicago 3
420 Chancery Bldg. • San Francisco 4

C-228

Fuller

PIONEERS OF HIGH-EFFICIENCY VANE-TYPE ROTARY COMPRESSORS

(*Continued from page 208*)
much higher figure and the new material has far outworn other materials in the same price bracket.

Under extensive field tests for a period of nearly two years, the new electrode has been subjected to every possible use in order to determine its suitability for equipment of all kinds. A great many users of hard-facing alloys have assisted in these tests and will recognize the product as "Experimental Electrode, Stoody 1293."

Deposition rate is far faster than can be attained with cast electrodes and the welded deposit is smooth, sound and free of pinholes or checks. With chromium and molybdenum as the principal alloys this material provides especially good resistance to all types of abrasion, exhibits high compressive strength and has excellent impact resistance. The electrode is readily weldable to all carbon and alloy steels including manganese. Deposits are semi-austenitic, and are not affected by ordinary heat-treat methods. Under normal welding procedure, either a-c or d-c, deposits show a Rockwell C hardness of 56-60; properties are retained at temperatures up to 800 F.

The advanced fabrication methods developed by Stoody Co. permit economical production of tubular hard-facing rods of this type, widely varying in analysis. The latest Stoody fabricated electrode has an unusually high alloy content and is economically priced to encourage wider use of superior quality hard-facing materials.

FORK TRUCK

▲Faced with the problem of congested plant areas due to indoor storage of heavy castings, and space taken up by coal bins, the Rockford Tool Co., Rockford, Ill., was able to take advantage of the yard area for storage by the use of a Clark "Yardlift" fork truck with a detachable 12-cu ft hydraulic shovel to handle and store the castings and to stockpile the coal.

(*Please turn to page 216*)

AMERICAN CHEMICAL PAINT COMPANY

AMBLER CHEMICALS ACP PROCESSES PENNA.

Technical Service Data Sheet

Subject: HOW GRANODRAW PHOSPHATE COATING FACILITATES COLD EXTRUSION OF STEEL

INTRODUCTION

By phosphate coating steel, prior to cold working it, extrusion, drawing, and other forming operations are greatly improved. In fact, it is the protective zinc phosphate coating that makes for the successful cold deformation of steel.

The tremendous pressures that most forming operations require produce extremely high frictional contact between die and metal. Without a protective coating, excessive galling (welding) of dies, breakage of tools, and unduly short die life will result. The combination of a non-metallic crystalline phosphate coating with an adsorbed lubricating film, possesses a low coefficient of friction while maintaining its stability under extremely high deforming pressures. This combination, therefore, greatly minimizes the aforementioned tool difficulties.

THE COLD EXTRUSION OF GENERATOR FRAMES

Cold extrusion is now being used advantageously in the manufacture of high production generator frames. This operation is facilitated by careful preparation and proper coating of the frame blank which is made from SAE 1010 open hearth plate steel.

After wheelabrating to remove the scale, the blank is rolled up and then fed automatically through a six stage dip wheel type washing machine which cleans the surface and applies the coating. The frame is then fed into an extrusion press where the wall thickness is increased on one end and reduced 47.5 percent on the other end. This operation produces concentric frames of uniform thickness and correct dimensions.

The Granodraw coating produces the proper surface to receive the lubricant by furnishing an extremely adherent film with the proper crystal size and continuity of coating required to insure maximum adsorbsion and tenacity by the lubricant. The lubricant, Montgomery DF 1101, is a combination of titre alkali soaps and resins. It is a powder which when dissolved in water and redeposited on the phosphate coated work piece, produces the necessary surface for subsequent operations. This film is dry and considerably less hydroscopic than similar coatings of the soap type. The concentrations of both the Granodraw and DF 1101 are maintained by simple chemical analysis.

PROTECTIVE COATING SEQUENCE

Stage	Operation	Chemical	Time	Temperature
1	Load and unload			
2	Cleaning	Tri-sodium phosphate and soda ash	1 Min.	180° F
3	Water rinse		1 Min.	180° F
4	Zinc phosphate coating	"Granodraw"*	4½ Min.	165° F to 180° F
5	Water rinse		2 Min.	180° F
6	Lubricating	H.A. Montgomery lubricant DF 1101	4½ Min.	190° F

*Trade Mark of the American Chemical Paint Company

CHEMICALS ACP PROCESSES

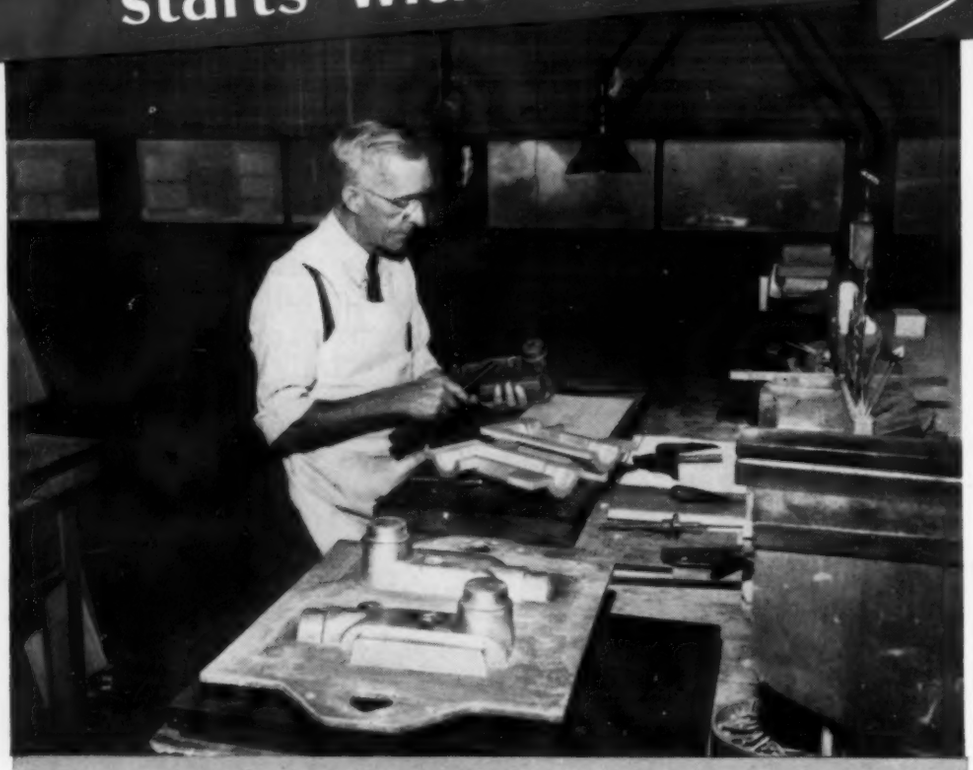
CROUSE-HINDS quality starts with the casting

Type FLB Explosion-Proof
Circuit Breaker Condulet

Type ARE Plug Receptacle
With Spring Door

Type GUAC Explosion-Proof
Junction Condulet

Type LB
Obround Condulet



1. A highly skilled patternmaker, with long years of experience in precision craftsmanship puts the finishing touches on an Obround CONDULET master pattern.

They're made right to serve you better.

Working from designs that have been carefully developed in the Engineering Dept., expert pattern-makers make the master patterns. Perfect workmanship is a tradition in Crouse-Hinds Pattern Dept., where half the workers have records of from twenty-five to more than forty years of service.

Crouse-Hinds Iron Foundry is one of the largest and best equipped of its kind. It has the latest mechanical improvements to enable the skilled molders to produce the best possible castings. Most CONDULETS are made of Feraloy, Crouse-Hinds special alloy having the desirable characteristics of both cast steel and gray iron. It is strong, tough, holds its shape, is inherently corrosion resisting, homogeneous, and machines well, giving sharp, full threads.

To maintain Crouse-Hinds high standard of quality there is constant checking and testing. In the Foundry Control Laboratory, core and molding sands and oils are examined. Only the best are used. Continual temperature readings of molten Feraloy are taken, and test bars are made and tested for strength in the Mechanical Laboratory. The Chemical Laboratory makes daily analyses of the Feraloy output of the foundry.

Crouse-Hinds Non-Ferrous Foundry is equipped to turn out high quality castings of aluminum, bronze, and other metals.

When quality counts use CONDULETS. They're made right ... to serve you better ... and last longer.

CROUSE-HINDS COMPANY
Syracuse 1, N. Y.

OFFICES: Birmingham — Boston — Buffalo — Chicago — Cincinnati — Cleveland — Dallas — Denver — Detroit — Houston — Indianapolis — Kansas City — Los Angles Milwaukee — Minneapolis — New Orleans — New York — Philadelphia — Pittsburgh — Portland, Ore. — San Francisco — Seattle — St. Louis — Tulsa — Washington.
RESIDENT REPRESENTATIVES: Albany — Atlanta — Baltimore — Charlotte — Corpus Christi — Richmond, Va. — Shreveport
Crouse-Hinds Company of Canada, Ltd., Toronto, Ont.

CONDULETS • TRAFFIC SIGNALS

. . . and goes thru every step

That's why CONDULETS* last longer

2. Expert molders operate the molding machines in Crouse-Hinds modern foundry. Sand hoppers are shown at top.

3. Molten Feraloy is poured into the molds from a distributing ladle in Crouse-Hinds mechanized foundry.

*CONDULET is a coined word registered in the U. S. Patent Office. It designates a product made only by the Crouse-Hinds Company.

CONDULET
First in the field
STANDARD OF QUALITY
A Nationwide Distribution Through Electrical Distributors

FLOODLIGHTS · AIRPORT LIGHTING

(*Continued from page 213*)

Rockford manufactures heavy metal-working equipment such as planers, slotters, shapers and lathes. The large unfinished components for these machines, such as bases, beds, columns, tables and gear boxes, which weigh up to four tons and range from approximately 24 in. x 35 in., to 40 x 100 in., were originally handled only by the large overhead cranes inside the building. As a result valuable plant space had to be used for storage.

Another storage problem was the coal supply for stoking furnaces. Approximately seventy-five tons of coal weekly are burned during winter months. The coal arrives in sixty-ton car loads and is placed directly in a storage bin. It costs approximately $45 to shovel manually an average sixty-ton car load of coal into the storage bin. When extra coal was unloaded, it was shoveled into a remote temporary storage area which reduced space available for more productive use. Also, the fireman had to wheel the coal from temporary storage to the furnace area, an objectionable and time-consuming operation.

Utilizing its hydraulic shovel attachment, this fork lift truck loads coal into receiving hopper. The operator and one helper can load more than 20 tons of coal an hour.

While management recognized the desirability of stockpiling coal in case of emergency conditions, it was impossible to do so inside the plant since it would further congest production facilities.

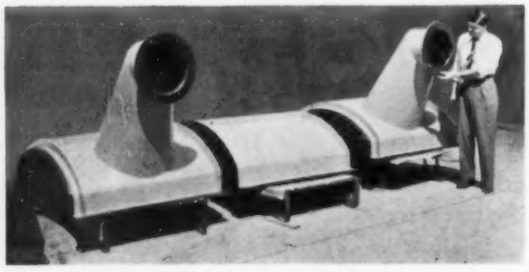
Analysis indicated that the yard area would have to be used for storage of both castings and coal; that some mechanical means would be required for loading coal into the storage bin; and equipment would have to be provided with enough capacity to handle the heavy castings. After some investigation it was concluded that with a fork-lift truck, and modification of some of the handling procedures, the problem could be solved at minimum cost. Accordingly, a "Yardlift-6024," equipped with "Dynatork" drive, a 112 in. standard upright, 42 in. forks, and a detachable shovel, was purchased.

The machine has sufficient capacity to handle all but one of the large castings used in the production of the machine tools. As a result, 10,000 sq ft of yard area is now used as a casting storage area, and the truck is able to move castings to and from production efficiently and quickly. Also, the truck is used to store some of the finished products in the outside warehouse. This procedure has made available to production valuable space inside the plant, formerly used for storage.

In addition to handling and storing machine parts, because it operates so quickly and efficiently, the machine is also available for coal handling. By use of the hydraulic shovel attachment, a machine operator and one helper are able to load ninety tons of coal into the storage bin in four hours. The company is now able to stock-

FOR MAXIMUM PROTECTION

From Corrosive Fumes and Liquids



Pickling Tank covers fabricated and lined for high temperature service with Neoprene Sheet Rubber in Heil Cleveland plant.

Specify HEIL Lined Equipment!

- RUBBER
- KOROSEAL
- SARAN RUBBER
- LEAD
- PLASTIC

Steel Pipe Lined with Neoprene Rubber for Temperature and Corrosion Resistance.

Write To-Day For Illustrated Literature

• You are assured longer service life and less maintenance cost by our expert workmanship and unbiased selection of the best lining materials for your specific requirement.

CHEMICAL-PROOF LININGS · TANKS HEATERS PLASTICS

Representatives Located in All Principal Cities

HEIL PROCESS EQUIPMENT CORPORATION

12901 Elmwood Avenue • Cleveland 11, Ohio

Other Heil Products Include: Lined Pickling Tanks • Acid-Proof Maintenance Material Lead Fabrication • Steam Jet Agitators • Monel Crates and Hooks • Lined Steel Pipe

Quick Relief

for SLITTING SERVICE Headaches

● If your monthly requirements of coiled strip exceed 100 tons, in many different widths and gauges, installing a Yoder slitter will not only result in worthwhile economies but in eliminating costly production bottlenecks.

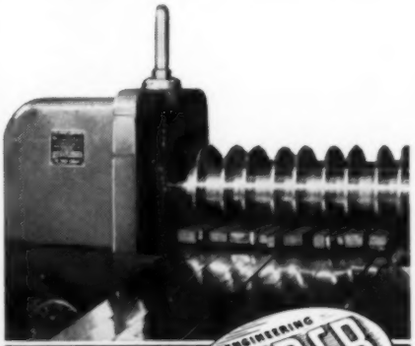
Coiled strip in standard widths is obviously lower in first cost than slit-to-width strip; the sources of supply are more numerous and deliveries much quicker.

The savings effected by doing your own slitting of moderate tonnages, soon pays for your investment in a Yoder slitter. Equally important, your inventory requirements and production planning are greatly simplified, as you can, from a relatively small stock of standard widths, in a few hours supply your own needs in slit strands.

The economies as well as the mechanics of slitter operation are fully discussed and illustrated in the Yoder Slitter Book, free on request.

THE YODER COMPANY

5495 Walworth Ave., Cleveland 2, Ohio



Rotary Gang SLITTERS

ENGINEERING YODER MANUFACTURING

pile six hundred tons of coal in the yard area between a railroad siding and the main building.

The automatic drive on the fork-truck makes for easier, quicker and smoother operation. The driver does not have to start-stop and clutch-declutch on forward and reverse movements. This also eliminates jarring the load due to "jerky" start and stop movements. Equally important, it makes for less driver fatigue.

CAB COOLER

▲Recently announced and now finding widespread application is the Lintern "Aire-Rectifier, Model 153AC-15," available in the self-contained and split unit types.

It maintains normal temperatures in crane cabs operating in temperatures up to 140 F and also provides complete air filtering under dust and gas conditions. This unit is being extensively specified for steel plants, aluminum plants and foundries — both domestic and export. It can be installed and connected by any competent refrigeration service man at low cost.

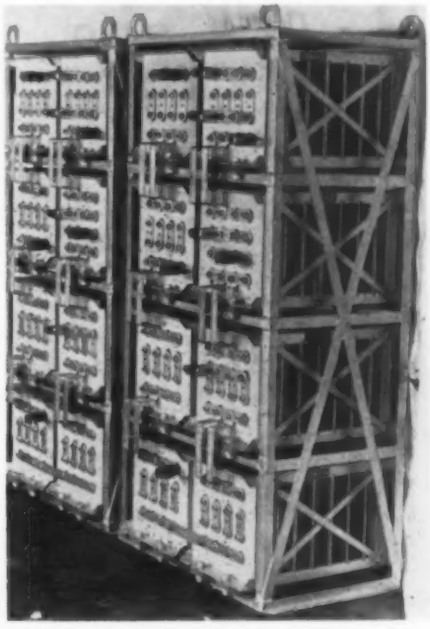
HEAT RESISTANT ALLOY

▲National Alloy Division of Blaw-Knox Co. announced that the lifting on November 1, 1953 of Government NPA order M-80 limiting the use of nickel will make their new heat re-

(*Please turn to page 220*)

GUYAN RESISTORS

CAN END YOUR RESISTOR TROUBLES!



Featuring helical coil resistance elements of chromium alloy steel, GUYAN Resistors are ruggedly constructed to withstand shock, vibration and overload.

●

GUYAN RESISTORS ARE CUSTOM BUILT TO YOUR REQUIREMENTS

●

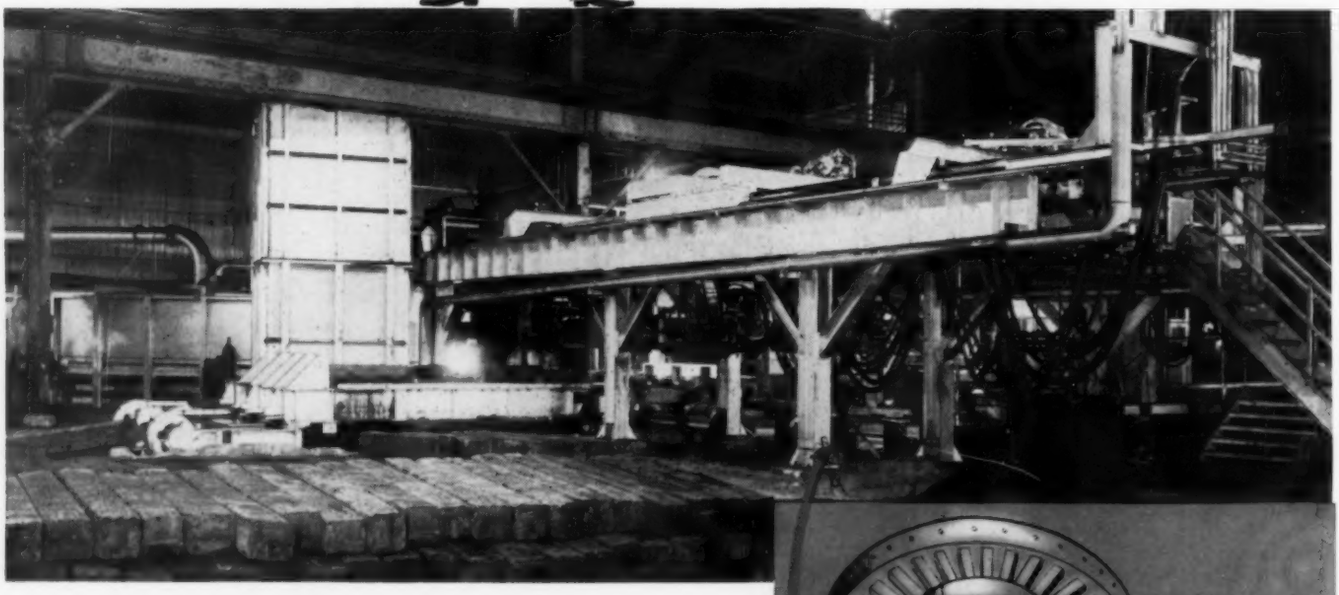
GUYAN MACHINERY CO.

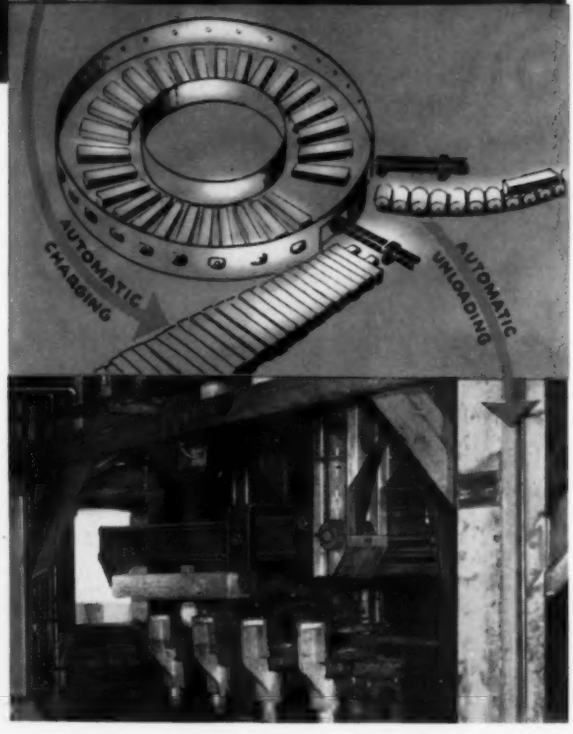
LOGAN, W. VA.

HAGAN

Automatic Rotary BLOOM HEATING FURNACE

~~ELIMINATE~~
~~Water Cooling~~
~~Wearing Skids~~
~~Stickers~~
~~Dummy Steel~~





Blooms charged and discharged *Automatically*

HAGAN AUTOMATIC ROTARY HEARTH FURNACES—

. . . **PERMIT** loading one, ten, twenty or more blooms into furnace to suit production requirements—under automatic control.

. . . **ELIMINATE** water cooled supports and skids. Blooms are automatically loaded and unloaded from a refractory hearth.

. . . **ELIMINATE** stickers. Blooms are handled individually and spaced apart on the hearth. Hearth can be unloaded at anytime without dummy steel.

. . . **PROMOTE** high efficiency by means of patented design, without recuperation by natural counterflow.

. . . **FURNISHED** from 9′ to 70′—and up to 100 tons per hour.

GEORGE J. HAGAN COMPANY
2402 E. Carson St., Pittsburgh 3, Pa.
CHICAGO • DETROIT

✔ *Check First with Hagan* **FOR ADVANCED ENGINEERING IN INDUSTRIAL FURNACE APPLICATIONS**

THE ENGINEERING MART

WHERE TO BUY
EQUIPMENT FOR SALE
POSITIONS VACANT
POSITIONS WANTED

AN *IRON and STEEL ENGINEER* SERVICE TO THE STEEL MILL OPERATORS

WHERE TO BUY

BIRMINGHAM DISTRICT

DIXIE ENGINEERING COMPANY
"Manufacturer's Agents"
P. O. Box 750 — 812-813 Protective Life Building
BIRMINGHAM 3, ALABAMA
Sabel E. Baum — Telephone 4-0417

CHICAGO DISTRICT

PAUL W. WENDT & SONS
Manhattan Building
CHICAGO 5, ILLINOIS
District Representatives for
A. W. CADMAN MFG. CO.
HUNTER SAW & MACHINE CO.
GRAFO COLLOIDS CORP.

EHRET AND KINSEY
Board of Trade Bldg., 141 West Jackson Blvd.
Chicago 4, Illinois — Wabash 2-0449
Representing
THE CLEVELAND WORM AND GEAR CO.
"Cleveland" Worm Gearing and Worm Gear Speed Reducers
THE FARVAL CORPORATION
"Farval" Centralized Lube Systems
LUBRICATION PRODUCTS COMPANY
"Stapax" Journal Box Lubricators
AMERICAN FLEXIBLE COUPLING COMPANY
"Amerigear" Flexible Couplings
WALDES KOHINOOR, INCORPORATED
"Truarc" Retaining Rings
2400 W. Clybourn St. — Phone:
Milwaukee 3, Wisc. — Division 2-7844

PHILADELPHIA DISTRICT

TOWLE & Son Co.
18 West Chelten Ave. — GE 8-1930
PHILADELPHIA 44
Representing:
THE TOOL STEEL GEAR AND PINION CO.
Cincinnati 16, Ohio

PITTSBURGH DISTRICT

ROLLING MILLS and EQUIPMENT
FRANK B. FOSTER, INC.
2220 OLIVER BUILDING PITTSBURGH 22, PA.
Cable Address "FOSTER" Pittsburgh

METALLIC RECUPERATORS
(Air Preheaters)
For application to soaking pits, heating, and other types of metallurgical furnaces.
HAZEN ENGINEERING CO.
Park Building — PITTSBURGH, PA.
COurt 1-7032

PATTERSON-EMERSON-COMSTOCK, INC.
ENGINEERS AND CONSTRUCTORS
Specializing in Steel Mill Construction
313 E. Carson Street
Pittsburgh 19, Pa.
Phone: EVerglade 1-9800

Auburn & Associates, Inc.
Engineers
ELECTRICAL LAYOUTS FOR STEEL MILLS
923 Penn Ave., Pgh. 22, Pa.
Telephone COurt 1-5014

W. G. KERR CO., INC.
520 Oliver Building — PITTSBURGH, PA.
Phone: ATlantic 1-4254
Representing:
FOOTE BROS.—Gears and SpeedReducers
REEVES—Variable Speed Drives
THOMAS—Flexible Couplings
WICHITA—Air Tube Disc Clutches & Brakes
TELSMITH—Telsmith Crushers
CULLEN-FRIESTEDT—Sheet Lifters—Welding Positioners—Track Cranes

CHEMSTEEL CONSTRUCTION COMPANY, INC.
204 Chemsteel Bldg., Walnut St., Pittsburgh 32, Pa.
Send data on Engineering & Construction facilities for
ACID-ALKALI-PROOF CONSTRUCTION
of pickling and other tanks; flooring.
(TEAR OUT & MAIL WITH LETTERHEAD)

PITTSBURGH (Continued)

RITTER ENGINEERING CO.
Engineers - Distributors - Contractors
1515 WEST LIBERTY AVE. — Phone:
PITTSBURGH 26, PA. — LOCUST 1-1303
Representing:
TRABON ENGINEERING CORP.
"Centralized Lubricating Systems"

OHIO LOCOMOTIVE CRANES
WELLMAN (Williams) Buckets
Clamshell — dragline — grab's
hook-on and special buckets
NORTHWEST crawler and truck-mounted cranes and shovels
LOCOMOTIVES — Diesel & Diesel Electric
New and Used Equipment
H. KLEINHANS CO.
Established 1911
560 ALCOA BUILDING
PITTSBURGH 19, PA. — Phone AT 1-4641

CONSULTING ENGINEERS

ROSS E. BEYNON
Consultant
ROLLING LAYOUT AND ROLL DESIGN
7658 Coles Avenue — Chicago 49, Illinois
Telephone SAginaw 1-3466

LOYAL R. MILBURN
Consulting Electrical Engineer
Registered State of Michigan
1928 Guardian Building • Detroit 26, Michigan
Telephone: Woodward 3-8706 or Whitmore Lake 5141

W. VANCE MIDDOUGH & ASSOCIATES
Consulting Electrical Engineers
Engineering • Design • Layout
Heavy Industrial Power & Light
204 Columbia Building .. Cleveland 15, Ohio
Prospect 1-2060

STEEL CITY ENGINEERING AND CONSTRUCTION COMPANY
Engineers & Builders of SPECIAL MACHINERY
Rehabilitation of Old Machinery & Furnaces of all Types.
Steel Mill Equipment & Construction.
Consulting Engineering Services,
Foundation Engineering & Construction.
Estimates & Appraisals of Plants & Equipment:
535 FIFTH AVE., PITTSBURGH 19, PA.
Phone EXpress 1-0780

THE ENGINEERING MART
(CONTINUED)

CONSULTING ENGINEERS

LOEDDING ENGINEERING CO., INC

CONSULTING, DESIGN AND DETAIL

Industrial and Commercial Planning
Bridges, Structures Of All Types
Material Handling
Conveyors, Gantry, Overhead and Jib Cranes
Reninforced Concrete and Foundations
Industrial Piping and Ventilation

ECONOMY BANK BUILDING • AMBRIDGE, PENNA.

PRODUCTS

Engineered-Rebuilding of your Machine Tools

SIMMONS MACHINE TOOL CORP.

Albany 1, New York

Pittsburgh Representative:
3541 Laketon Road PEnhurst 1-3700

MODERN
MILL OPERATORS' PULPITS
DESIGNED BY
WALLACE F. SCHOTT
CONSTRUCTED BY
JAMES CAMPBELL SMITH, INC.
WILLOUGHBY, OHIO

POSITIONS VACANT

ASSISTANT CHIEF ENGINEER

Must have experience in general steel plant maintenance and construction. Eastern location. Give full details as to training, experience, age and salary expected. Box 1101, IRON AND STEEL ENGINEER, 1010 Empire Bldg., Pittsburgh 22, Pa.

POSITIONS WANTED

ELECTRICAL ENGINEER

BA Sc (EE) '51, 28 years old, married, eight months telephone power equipment engineer, two years design and layout of electrical equipment for modern hot and cold strip mill. Desire engineering position that has opportunity for advancement based on ability and initiative. Resume on request. Box 1102, IRON AND STEEL ENGINEER, 1010 Empire Building, Pittsburgh 22, Pa.

EQUIPMENT NEWS

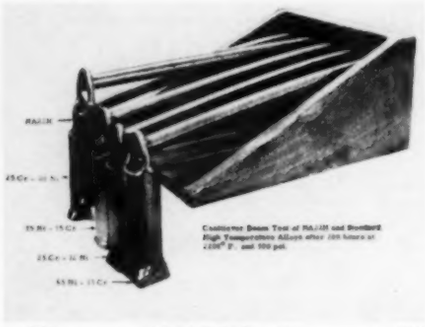
(*Continued from page 217*)

sistant alloy NA22H generally available.

This regulation has prevented the use of NA22H except in certain uses at temperatures above 2000 F where its use could be shown to result in definite savings in the amount of nickel used.

NA22H is a new alloy developed by National Alloy Division after more than 10 years laboratory and field testing. It can be used at temperatures up to 2200 F, which is 200 F above the previous design limit for heat resistant alloys.

Although the application of this alloy has been limited by the government to special applications above 2000 F, the alloy will also show big savings in many uses in the 1700 F—2000 F range because of its superior structural stability and resistance to oxidation.



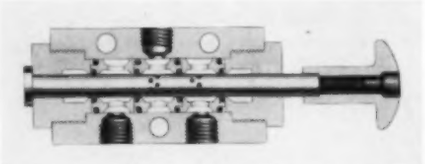
The use of NA22H will permit (1) increased furnace capacity and efficiency by increasing the rate of heating through use of higher heat heads, (2) practical engineering design permitting temperatures up to 2200 F, and (3) longer alloy life per dollar invested.

This development has attracted the interest of furnace manufacturers, operating metallurgists, fuel engineers, ceramic engineers and power boiler engineers.

CONTROL VALVE

U. S. Patent No. 2,645,450 granted to S. C. Cheesman and assigned to C. B. Hunt & Son, Inc., Salem, Ohio, covers a new interior construction for control valves that greatly simplifies the valve, and assures positive positioning of the sealing packers without placing any mechanical pressure on the packers themselves.

The principal parts consist of a housing with straight through bore; gland nuts for the ends; a hollow radially ported ground and polished stainless steel plunger; internal spacers that are held firmly in metal-to-metal end abutment; and two sizes of "O" rings.



In assembly, the "O" rings are placed on the shoulders of the spacers, which are then inserted in the housing. Tightening the gland nuts positions the spacers accurately in the housing and holds the "O" rings in position without subjecting them to any mechanical pressure. The "O" ring packings are subjected only to the fluid pressure in the adjacent chambers.

Wear is practically eliminated. All parts are in pressure balance avoiding any tendency to creep or crawl. Maintenance is extremely low, and under normal conditions consists simply of the very occasional replacement of the "O" packings. This can be accomplished easily and quickly in the field by simply removing the gland nuts, usually without even disturbing the connecting piping, thus avoiding the expense of maintaining large standby inventories, or the delay occasioned by returning valves to the factory for servicing.

Valves using this unique construction are available in push-pull, push spring return, hand, foot, cam, diaphragm, pilot, and single or double solenoid operated, with 2-way, 3-way, 4-way or 5-way actions and either open or closed exhaust.

Safer . . . Happier

thanks to
Christmas Seals!

Like a protective radar network, a barrier formed by Christmas Seals helps to guard us against tuberculosis.

The money which *you* donate for Seals fights TB the year round — with continuing medical research, education, rehabilitation, and case finding.

To keep the barrier high, send your contribution today, please, to your tuberculosis association.

Buy Christmas Seals

Because of the importance of the above message, this space is contributed by **IRON AND STEEL ENGINEER**

INDEX TO ADVERTISERS

NOVEMBER, 1953

A

Aetna-Standard Engineering Co. 1
Ajax Flexible Coupling Co. 194
Alliance Machine Co. 131
Allis-Chalmers Manufacturing Co. 4, 5
American Brake Shoe Co., American Manganese Steel Division 6
American Brake Shoe Co., Electro Alloys Division 47
American Brake Shoe Co., National Bearing Division 21
American Chemical Paint Co. 167, 213
American Flexible Coupling Co. 186
American Wheelabrator and Equipment Corp. 196
Anker-Holth Division, Wellman Engineering Co. 170
Askania Regulator Co. 209

B

Bailey Co., William M. 208
Bailey Meter Co. 188
Bedford Foundry and Machine Co., The 200
Birdsboro Steel Foundry and Machine Co. 151
Blaw-Knox Co., Machinery Division 17
Blaw-Knox Co., Rolls Division 30
Bliss Co., E. W. 25
Brooks Oil Co. 44
Browning and Co., Inc., Victor R. 203
Bussmann Manufacturing Co. 142, 143

C

Cities Service Oil Co. 134
Clark Controller Co. 26
Clark Equipment Co., Ross Carrier Line, Industrial Truck Division 166
Cleveland Crane and Engineering Co., The 48
Cleveland Quarries Co., The 175
Continental Foundry and Machine Co. 7
Cooper Split Roller Bearing Corp. 121
Crane Co. 138
Crouse-Hinds Co. 214, 215
Cutler-Hammer, Inc. Cover 2

D

Documentation and Licenses, Paris, France 52
Dowell, Inc. 158
Dravo Corp. 189
Drever Co. 41

E

Electric Controller and Manufacturing Co., The 16, 36, 161
Electric Service Manufacturing Co. 154
Elliott Co. 32, 33
English Electric Manufacturing Co. of Canada, Ltd. 137

F

Falk Corp., The 35
Farnco Sales Co. 192
Farrel-Birmingham Co., Inc. 27
Farrell-Cheek Steel Co. 147
Farval Corp., The Cover 3
Fischbach and Moore, Inc. 173
Flinn and Dreffein Engineering Co. 52
Foote Brothers Gear and Machine Corp. 182
Fuller Co. 212

G

General Electric Co. 148, 149, Cover 4
General Motors Corp., Hyatt Bearings Division 145
Gulf Oil Corp. 42, 43
Guyan Machinery Co. 217

H

Hagan Corp. 201
Hagan Co., George J. 218
Hallden Machine Co., The 52
Hauck Manufacturing Co. 155
Hazen Engineering Co. 128
Heil Process Equipment Corp. 216
Heyl and Patterson, Inc. 18
Hunt and Son, Inc., C. B. 155
Hyde Park Foundry and Machine Co. 204

I

Ideal Industries, Inc. 204
Industrial Gear Manufacturing Co. 207

J

Johns-Manville Corp. 193
Jones Foundry and Machine Co., W. A. 211
Joy Manufacturing Co. 8

K

Koppers Co., Inc. 12, 141, 156, 157

L

Lake Erie Engineering Corp. 39
Leeds and Northrup Co. 13
Linde Air Products Co., Division of Union Carbide and Carbon Corp. 126
Link-Belt Co. 103

M

Manning, Maxwell and Moore, Inc. (Shaw Box Division) 34
Martindale Electric Co., The 174
McKiernan-Terry Corp. 210
Mesta Machine Co. 222
Miles and Partner, John (London, Ltd.) 52
Minneapolis-Honeywell Regulator Co. 152, 153
Morgan Construction Co. 122
Morgan Engineering Co. 181

N

National Carbon Co., Division of Union Carbide and Carbon Corp. 45, 178
Northern Engineering Works 46

O

Ohio Electric Manufacturing Co., The 185
Okonite Co., The 40

P

Pacific Pumps, Inc. 187
Pennsylvania Transformer Co. 28, 29
Pittsburgh Lectromelt Furnace Corp. 54
Plasteel Products Corp. 31
Pollock Co., The William B. 195
Poole Foundry and Machine Co. 177
Post-Glover Electric Co. 164

R

Reliance Electric and Engineering Co. 38
Rowan Controller Co. 190
R-S Furnace Corp. 168, 169
Rust Furnace Co. 101
Rust-Oleum Corp. 136

S

Salem-Brosius, Inc. 37
Selas Corp. of America 20
Semet-Solvay Engineering Division, Allied Chemical and Dye Corp. 14, 15
Shell Oil Co. 3
Smeeth-Harwood Co. 192
Spraying Systems Co. 192
Square D Co. 139
Standard Boiler and Plate Iron Co. 191
Surface Combustion Corp. 10, 11

T

Taylor Chain Co., S. G. 202
Timken Roller Bearing Co., The 133, Cover 1
Tool Steel Gear and Pinion Co. 19
Torrington Co., The, Bantam Bearings Division 197
Trabon Engineering Corp. 198
Treadwell Co., M. H. 125
Truflo Fan Co. 172

U

Union Carbide and Carbon Corp., Linde Air Products Co. 126
Union Carbide and Carbon Corp., National Carbon Co. 45, 178
United Engineering and Foundry Co. 104
United States Graphite Co., The 206

W

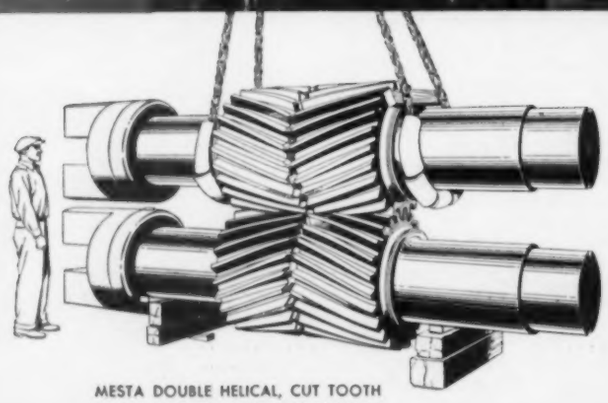
Wagner Electric Corp. 205
Wapakoneta Machine Co. 174
Wean Engineering Co., Inc., The 52
Wean Engineering Co. of Canada, Ltd. 52
Wean Equipment Corp. 52
Wellman Engineering Co., The 171
Westinghouse Electric Corp. 50, 51, 162, 163
Wilson Engineering Co., Inc., Lee 9

Y

Yoder Co. 217
Youngstown Alloy Casting Corp. 2
Youngstown Foundry and Machine Co. 22

MESTA

MODERN REVERSING SLABBING-BLOOMING MILLS



MESTA DOUBLE HELICAL, CUT TOOTH SLABBING-BLOOMING MILL PINIONS

MESTA 46" TWO-HIGH REVERSING SLABBING-BLOOMING MILL

Designers and Builders of Complete Steel Plants

MESTA MACHINE COMPANY

PITTSBURGH, PENNSYLVANIA

FARVAL SPRAY VALVES save 95% of lubricant and do 100% better job

FARVAL—*Studies in Centralized Lubrication*
No. 149

COUNT the number of open gears on your machines. Multiply the amount of grease required for these gears by 95% and you'll have the savings in lubricant alone which Farval Spray Valves can bring.

Even more important than lubricant saving, the Farval Spray Valve spreads and maintains a uniform thin film of oil or grease evenly over all bearing areas —eliminates friction, increases efficiency, lowers power costs, reduces wear.

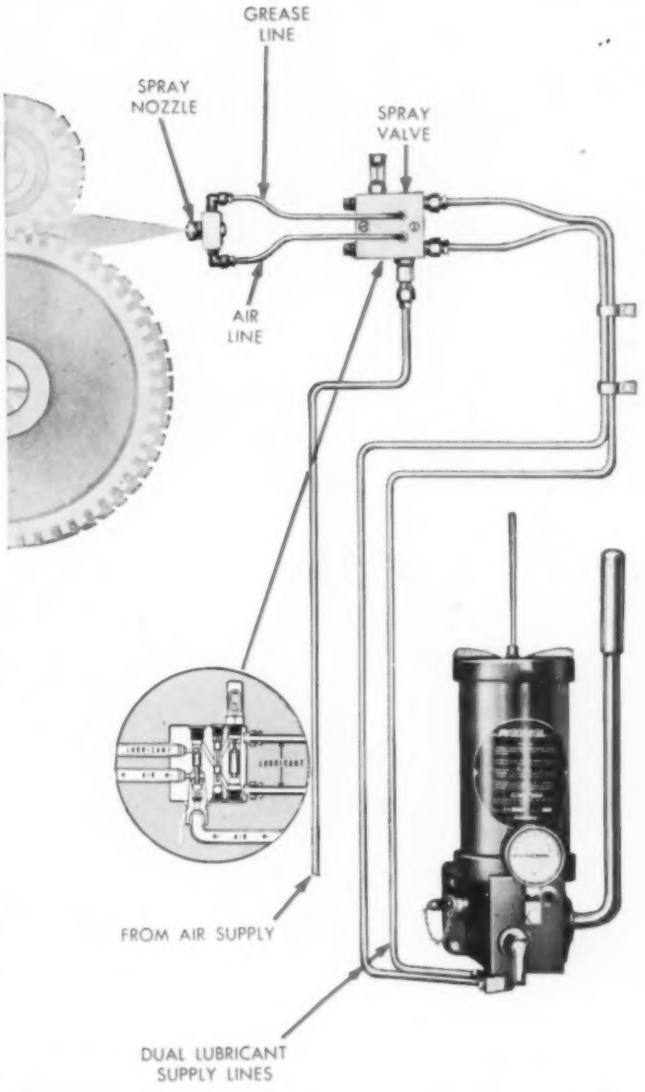
The Farval Spray Valve System is designed especially for lubricating open gearing and slide surfaces. Using an adaptation of the familiar Dualine Valve, this system sprays oil or grease from nozzles in just the right amount and at any desired interval.

No more wasteful hand paddling of lubricant on gear teeth with the hope it will spread itself uniformly. No more blobs of grease splotching up the floor—creating safety hazards. The Farval Spray Valve System has proved it can maintain a clean, even film of lubricant at all times while machines are in operation. No waste. No mess. No trouble.

Farval Spray Valves can be inserted in a regular Farval Dualine System wherever compressed air is available. Or a complete Farval Spray Valve System may be installed, consisting only of Spray Valves served by a manual or automatic pumping unit. As indicated in the sketch at right, compressed air is directed through the Spray Valve, which meters air to the delivery nozzle at the same time that the lubricant is metered. Positive cut-off after delivery eliminates bleeding.

Why not insure that your open gearing and slide surfaces get the lubrication they need? Write for a copy of Farval Spray Valve Bulletin No. 60 today. The Farval Corporation, 3278 East 80th Street, Cleveland 4, Ohio.

Affiliate of The Cleveland Worm & Gear Company, Industrial Worm Gearing In Canada. Peacock Brothers Limited.



Drawing shows component parts of the Farval Spray Valve Centralized System of Lubrication—manual pumping station, dual lubricant lines, compressed air line, single Spray Valve and nozzle. Both automatic and manual systems installed three years ago are in operation today, prolonging gear life, saving labor and lubricant.

G-E LIMITAMP CONTROL stands ready to check short-circuit conditions from high-voltage overloads on synchronous and induction motors up to 4800 volts. Limitamp's high interrupting capacity prevents equipment damage and costly shutdowns.

G-E Limitamp Control means "safety first" for personnel and high-voltage equipment

PROTECT YOUR EQUIPMENT from the explosive and shattering effects of sudden electrical overloads with General Electric Limitamp control . . . and be assured of equipment protection against short-circuit conditions up to 250,000 kva.

With General Electric Type EJ-2 fuses, fault current is limited in less than ¼ cycle . . . and the air-break contactor offers rugged service for millions of operations.

SAFEGUARD YOUR PERSONNEL by taking advantage of G-E Limitamp's "safety first" features. High- and low-voltage compartments are separated by a steel barrier. A mechanical door interlock assures opening of the motor circuit before the fuse compartment can be opened.

FOR YOUR OWN REQUIREMENTS, individual components need not be specified. Our application engineers select the correct components to give you proper control and sufficient interrupting capacity.

FOR COMPLETE INFORMATION about G-E Limitamp controls and how your particular operation can benefit, contact your nearby General Electric Apparatus Sales Office, or write Section 781-6 for Bulletin GEA-5409 today. *General Electric Company, Schenectady 5, New York.*

EASY TO MAINTAIN. Arc shutes are easily removed, contact tips quickly inspected, and G-E Limitamp is back on the job.

You can put your confidence in—

GENERAL ELECTRIC